

Mechanical

# AUTOMOTIVE INDUSTRIES

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NOVEMBER 27, 1937

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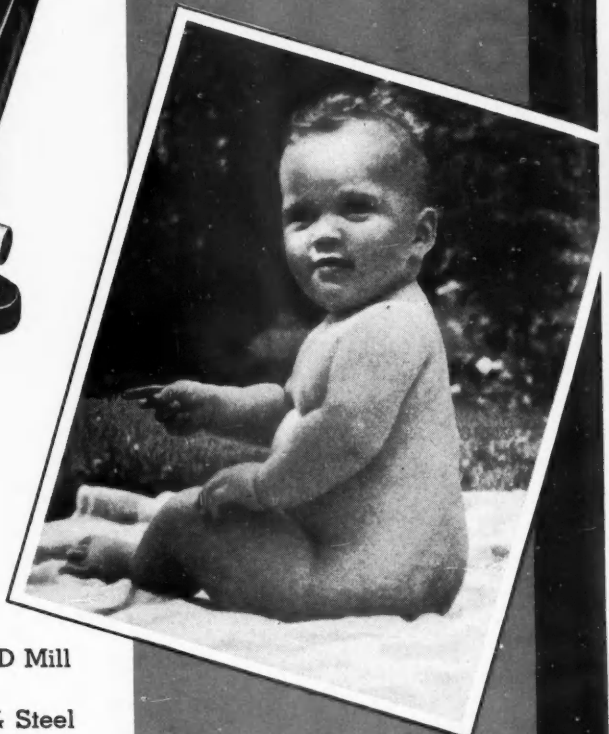
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# AUTOMOTIVE INDUSTRIES

## AUTOMOBILE

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November 27, 1937

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Automotive Industries



# AUTOMOTIVE INDUSTRIES

## Production Trimmed to Demand

*Four-day Week Expected at Most Plants for December; Some Companies to Work After Holiday; Ford Output Gaining*

Determined to bring production into line with retail demand, automobile manufacturers are further trimming down their operating schedules for the balance of the year. A four-day week is expected to prevail at a majority of plants during December. There probably will also be extended holiday closings, with some taking advantage of the full week between Christmas and New Year's to shut down.

Further retrenchment is understood to have been prompted by recent sales reports which have not been up to expectations. In many instances, the rate of retail deliveries had held up around the 1936 level until about the middle of the month when late returns began to show more than seasonal contraction.

An additional factor was the relatively big field stocks built up by companies which had started new model production earlier than last year. For the entire industry, passenger car stocks at the end of October were roughly 116,000 units or about 57 per cent higher than they were a year ago, and had risen 32 per cent during the month. That is, they were considered on the high side in view of the season and the condition of demand.

The major part of the industry was on a three-day basis during the past week, with many plants closing for the Thanksgiving holiday and planning not to reopen until Nov. 29. There were some exceptions, however. While all observed the holiday, Packard and Graham found it necessary to make up lost time by working both Friday and Saturday. Ford plants resumed on Friday as did Oldsmobile and Hupp. Ford production has been picking up at a good rate and is expected to reach 3000 units a day by the end of the month. However, a year ago Ford output was up to 4500 units daily by the end of November. Most of the branches are back in operation and production of the new models has also been started at the Canadian plant.

The increasing rate of output at the Ford plants should offset the sagging tendency at others next month and may serve to keep the industry's production on an even keel for the balance of the year. Upwards of 375,000 cars and trucks are indicated each month for

November and December. Such retrenchment as now is scheduled will not endanger the industry's 1937 goal of 5,000,000 units, although earlier estimates running well in excess of this figure certainly will have to be cut down. It looks now as though about

(Turn to page 771, please)

## Strikes Hit Parts Units

*Briggs, Wilcox-Rich, Others Halted by Troubles*

Automobile parts manufacturers were affected during the past week by several strikes.

Disciplining of a shop steward was given as the reason for the closing of "K" building of the Briggs Mfg. Co. in Highland Park, Mich., on Nov. 23. According to company officials, the shop steward refused to obey a company order and was discharged. When a group of workmen objected, the company said, the entire division was closed and the 400 workers sent home. The division does work on Plymouth bodies. The men returned to work Nov. 24.

Approximately 1000 workers of the Wilcox-Rich division of the Eaton Mfg. Co. remained idle Nov. 23. The plant was closed due to labor trouble. Five



**DR. C. D. SELBY**  
... medical director, General Motors Corp., in charge of the organization's health protection.

hundred employees on the day shift declared a 10-minute production recess Nov. 22 while they ironed out union difficulties. Upon declaration of the recess, the plant management sent the

(Turn to page 766, please)

## Total Registrations Hit Peak

*New Record of 29,613,943 Vehicles in U. S. is Made; Mark Set for Second Consecutive Year; Truck Gain Widest*

For the second consecutive year all previous total-motor-vehicle registration records will be broken, according to a preliminary estimate just completed by AUTOMOTIVE INDUSTRIES. Our estimate places the new peak at 29,613,943 as compared with the previous high point last year of 28,221,297, an increase of approximately 5 per cent.

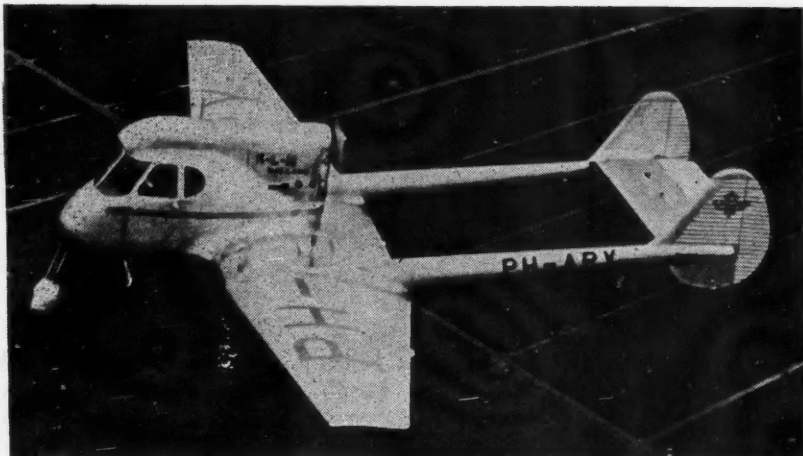
In the short span of a quarter of a century total registrations have increased from slightly under a million in 1912 to nearly thirty times as many during 1937. Large increases were felt each year until the peak of 1930 when 26,545,000 motor vehicles were registered. Declines followed until 1933 resulting in registrations for that year of

23,844,000 units. 1936 topped the previous high of 1930 by approximately 1,676,000, but it now appears that 1937 will exceed 1936 by some 1,400,000 vehicles.

Of the 29.6 million vehicles registered this year, 25,455,222 are passenger cars and 4,158,721 are trucks and buses. Commercial vehicles will show the largest gain over last year of about 6 per cent while passenger cars will exceed last year by approximately 5 per cent.

Colorado indicates the largest percentage increase over 1936 with 12.2 per cent, followed by Oregon with 9.3, Arizona with 9.1, Florida with 8.9,

(Turn to page 767, please)



## LANDING SAFETY

is said to be assured through the use of a new airplane landing gear, shown in the picture. It involves the use of a tricycle arrangement with one wheel forward under the nose of the ship and the other two under the wings. Experiments are being carried out by

the KLM, Royal Dutch Airlines, and it is reported that the gear may soon be attached to large transport ships. The plane shown is an American Stearman-Hammond "Y," which it is said can take off without touching the controls. The front landing wheel is to prevent nosing-over when landing.

## URW Assails Davey

*Rubber Workers File Charges with NLRB*

Formal charges of violations of Section 10-B of the National Labor Relations Act have been filed with the National Labor Relations Board against the Goodyear Tire & Rubber Co., and Governor Martin L. Davey of Ohio, by the Goodyear local, United Rubber Workers Union of America, a CIO affiliate, as an aftermath of the latest CIO flare-up in the tire industry which closed the Akron Goodyear tire plants for three days.

The Goodyear factories were reopened when employees, who had evacuated the plants after a two-day sit-down strike in protest against layoffs of 1600 of their number, voted to return to their jobs. Their mass meeting and return-to-work vote followed announcement by Goodyear officials that the Goodyear factories would open Nov. 22 for all employees desiring to work "despite hell or high water," and action of Governor Davey in ordering 2000 Ohio National Guardsmen mobilized for emergency duty in Akron. CIO leaders publicly stated that the Goodyear employees' vote to go back to their jobs averted a general strike of all CIO unions in Akron, which they claimed would have been called had Governor Davey made good his threats to send troops into Akron.

In putting troops on notice for quick service in Akron, while more than 3000 Goodyear employees were pursuing their sitdown strike in the factories, Governor Davey branded the Goodyear sitdown strike as "illegal, immoral and revolutionary." Shortly afterwards, upon advice of union leaders, the strikers evacuated the plants. Prior to the Goodyear return-to-work vote taken Sunday, Mayor L. D. Schroy had ordered all Akron policemen to report for duty at the factory early Monday.

In filing the charges against Goodyear and Ohio's Governor, the Goodyear CIO local charged Goodyear with having broken off relations with the union, and charged Governor Davey with intimidation of the Goodyear workers. Union leaders cited the fact that press reports from Columbus stated Governor Davey in notifying the press of his action in the Akron crisis, had asked: "Will this make the big wires?" and charged that his threat of calling out troops indicated that his action was taken "in furtherance of his own selfish personal political ambitions."

Under the terms of the peace pact reached between Goodyear and union officials, the company pledges that there will be no further layoffs in the tire and tube divisions beyond the present layoff program involving 1642 men, and that in the future seniority rights will be observed.

## French Car Bodies Newly Defined

The meaning given to the four leading types of bodies—coupé, coach, berline and limousine—has been standardized by the French Society of Automobile Engineers.

A coupé is a closed car with two doors and two windows; the coach has two doors and four windows; the berline has four doors and four windows; and the limousine four doors and six windows. The nomenclature of convertible bodies has not been standardized. Although a French word, the expression "sedan" is never used—probably because of its unfortunate historic significance. Exporters to French-speaking countries would be well advised to avoid its use, it is held.

## Equipment Flexible

*Chevrolet's Buffalo Plant Easily Rearranged*

All the machinery will be mobile or removable at the new \$12,000,000 Chevrolet plant at Buffalo, N. Y., now nearing completion and expected to be in production early next year.

In arranging the equipment, factory officials will carry out the "mobility" idea much further than it has ever been tried before. The machines and equipment can be shifted around like furniture in a house. With the exception of the very heaviest equipment, none of the 1500 machines will be anchored to the floor. All will rest on creosoted wood blocks.

All of the conduits and pipes for electricity, gas, oil and compressed air will drop from overhead ducts. Nearly all of the machines will be individually driven by motor and there will be none of the overhead belts and pulleys characteristic of manufacturing plants.

A huge "layout board" in the plant superintendent's office will show the entire plant arrangement. Pieces of card—(Turn to page 769, please)

## Eyston Sets Record

*Drives Car at 311.42 m.p.h. For Two Runs in Utah*

A new world land speed record was set by Capt. G. E. T. Eyston, Great Britain, on the Bonneville Salt Flats in Utah on Nov. 19 when he drove his 24-cylinder "Thunderbolt" racing car at an average of 11.56 seconds or 311.42 m.p.h. for north and south runs over a measured mile. Balked by clutch trouble on two preceding tries, Capt. Eyston gave indications then that his car would set a new record as it travelled at 309.6 m.p.h. and 310.685 m.p.h. on two of the runs.

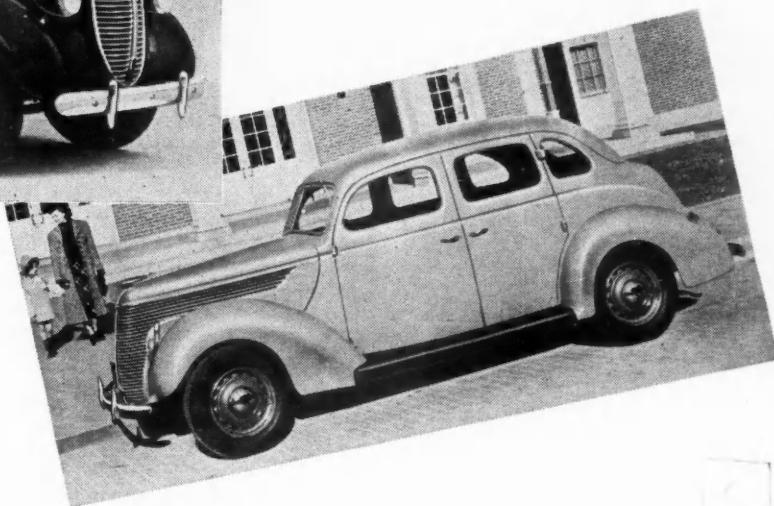
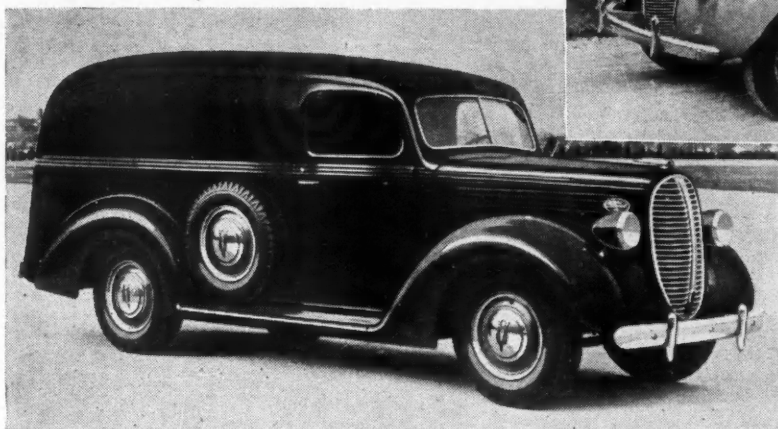
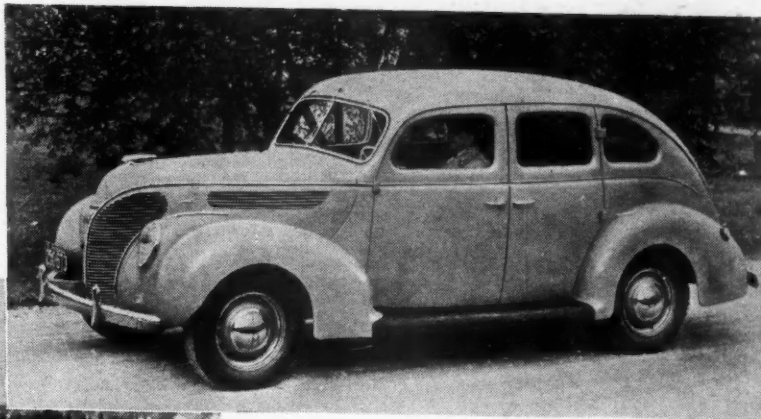
Moving northward on the first of the two legs required to establish an official record, Capt. Eyston drove the car over the mile in 11.79 seconds or 305.34 m.p.h. Retiring, southward, the car covered the mile in 11.33 seconds or 317.74 m.p.h. Within the southward mile, a kilometer (1.6 kilometers equals one mile) was covered in 7.01 seconds or 319.11 m.p.h.

Capt. Eyston reported that he had had to drive part of the high-speed distance with one hand while he straightened his fluttering goggles with the other.

The car is 30 ft. long and is powered with two 12-cylinder Rolls Royce engines developing about 5,000 hp. It has four steering wheels at the front with the forward pair mounted on a narrower tread than the rear pair. Duals at the rear of the car provide traction. The clutch trouble was on the left side of the car and was remedied through the manufacture of a new one in Los Angeles, Cal., with the assistance of three American Automobile Association officials.



**NEW STYLING** marks the appearance of the 1938 Ford cars and trucks. At the right is shown a deluxe Fordor sedan which has the luggage compartment concealed at the rear, and below it is the standard Fordor sedan. The truck model illustrated is a new "one-tonner." Standard passenger cars have either the 85 hp. or the 60 hp. engine, while the deluxe cars come only with the 85 hp. engine. The truck comes with either engine.



## New Fords Announced

### Detailed Description of Line Officially Given

Official announcement of the details of the new 1938 Ford line was made Nov. 30. There are two passenger car series, the standard line, available in coupe, Tudor and Fordor body types with either the 85 hp. or 60 hp. engine, and the deluxe line, available in eight body types with only the 85 hp. engine. Bodies include coupe, Tudor and Fordor sedans, club coupe, convertible cabriolet and club convertible cabriolet, convertible sedan and phaeton. Chassis is the same for both lines and the wheelbase is 112 in.

The commercial car lines include four wheelbases, 112-in., 122-in., 134-in. and 157-in. Entirely new is the "one-tonner" on the 122-in. wheelbase. Choice of either engine is available in all of the two smaller models excepting for the station wagon which has the 85 hp. engine. The two larger sizes have the 85 hp. engine. Details of the commercial and truck lines were published in *AUTOMOTIVE INDUSTRIES*, issue of Nov. 13.

The passenger car lines differ decidedly in appearance. The hood top is drawn far forward and downward over the radiator grille in the deluxe models, with the styling new throughout. Luggage compartments are concealed in the deluxe series. Front end of the standard series is newly styled, horizontal grille bars running backward along the side of the hood to form louvres. Headlights are recessed in the front fender aprons and tail lights are flush-fitted into the tips of the rear fenders. Both series have all-steel bodies with no metal-to-metal contact with the frame.

Interiors are restyled, with the deluxe series providing more space than before. Instrument panels are new and have space for radio installation in the middle of the panel. Front and rear seats are said to be wide enough for three persons. Tudor sedan front seats have full width cushions, the back divided and movable to permit entry to the rear compartment. Rear quarter windows of the deluxe Fordor sedan and club coupes are pivoted for ventilation in addition to the Ford ventilating system.

Mechanical changes include softer springs, improved cable-controlled brakes and engine refinements to provide better performance, particularly at lower car speeds. The cars have semi-centrifugal clutches, full torque tube drive, and straddle-mounted rear axle pinions.

Included as standard equipment on Ford V-8 cars for 1938 are the following:

Standard: Front and rear bumpers and guards, spare wheel, tire and tube, tire lock and band, one tail light, one windshield wiper, one sun visor, cigar lighter, headlight beam indicator and twin horns.

Deluxe: Twin tail lights, two windshield wipers, two sun visors, twin electric horns, cigar lighter, deluxe steering wheel, glove compartment

clock and lock, chrome wheel bands, in addition to front and rear bumpers and guards, spare wheel, tire and tube, lock and band, and headlight beam indicator.

### New Goodrich Cotton Cord

A new type of cotton tire cord, designed primarily to reduce heat generated at high speeds in truck and bus tires, is announced by T. G. Graham, vice-president of The B. F. Goodrich Co., Akron, Ohio.

The new cord is of entirely different construction, according to the manufacturer.

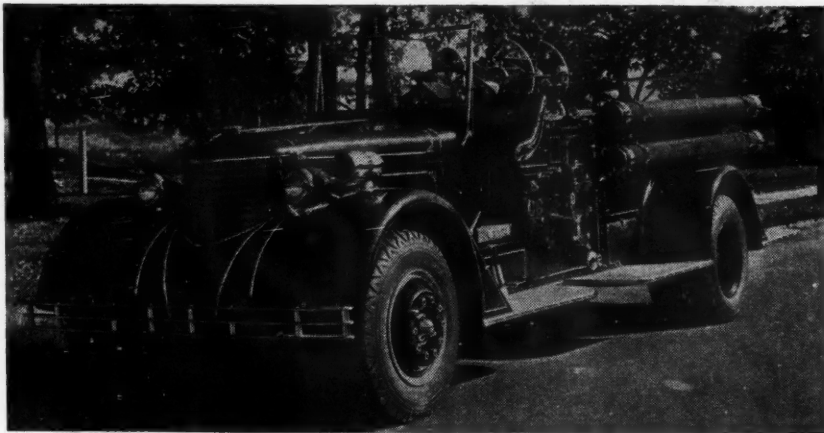


**LOWELL F. SARNES** has been appointed chief engineer of the Monarch Governor Co., it was announced by James Anderson, Jr., general manager. Mr. Sarnes has been assistant engineer for the past two years.

**C. S. McMORROW**, for many years a factory representative for a number of automotive lines, has been made sales manager of the Dyas Rubber Mfg. Co., Kansas City, maker of rubber accessories for automobiles.

**GUSTAVE KLINKENSTEIN**, vice-president and technical director, Maas & Waldstein Co., addressed the American Electro-Platers' Society at Springfield, Mass., Nov. 20 on the specialization of finishes.





### DIESEL FIRE UNIT,

a Stutz model F-D, with a wheelbase of 173 in. It is powered with a six-cylinder Cummins Diesel, rated 155 hp. at 1800 r.p.m. Safety while re-

fueling near fire scenes, immunity to water-caused stalling and quick starting are claimed as advantages. The truck is completely equipped with fire fighting apparatus. It has hydraulic four-wheel brakes.

## Strikes Hit Parts Units

(Continued from page 763)

workers home and locked the doors.

The plant, which manufactures automobile parts, has been operating under an agreement with the UAW. Union officials asserted the employees voted not to return to their jobs until negotiations for a closed shop had begun.

Three hundred sitdown strikers continued to hold the Bundy Tubing Co. plant in Detroit while officers of the UAW announced that negotiations would be resumed with the management on union demands. The strike started at 7 a.m., Nov. 22, when officers of the UAW Local 369 locked the factory gates with chains after the day shift had entered. According to Kenneth Scott, UAW organizer, the move was made with the sanction of the UAW International officials. W. W. Anderson, president of the company, said the company had been negotiating with union representatives since Oct. 21 in an effort to reach an agreeable contract. No negotiations are being held now and none are scheduled.

Despite the resignation of three of the officers of the Independent Association of Chrysler employees last week, who transferred to the UAW, organizational work in the Chrysler Corp. plants will continue, Earl L. Liddell, president and founder, said. He charged that valuable papers proving the use of strong-arm methods by the UAW in organizing the employees of the Chrysler Corp. had vanished at the same time the three officers had resigned. Ernest La Brecque, vice-president, who resigned last week, denied that there had been any such statements or valuable papers.

Members of the Cadillac Motor Car Co. local of the UAW voted not to call a strike Nov. 29. This was done at the suggestion of Homer Martin, UAW president. The local voted to negotiate the case of four men suspended as a result of a strike of foundry employees a week ago.

A strike of UAW workers at the Ford assembly plant in St. Louis failed to halt operations. Non-striking employees walked through the picket line and forced their way in with automobiles. The production line started operations on scheduled time. The strike was called by Delmond Garst, regional director of the UAW.

Charges against the Ford Motor Co. and eight men growing out of the riot at the Ford River Rouge plant last May when the UAW attempted to pass out union literature, were quashed by Circuit Judge Lester S. Moll. Judge Moll made his ruling on a motion by Harry S. Toy, Ford attorney. The court found lack of intent to commit the offenses charged.

Removal of the headquarters of the UAW's Ford organizational drive in the Detroit area from the former bank building at Michigan Avenue and Addison Street to the Hofmann Building, was announced.

At the same time it was stated that the customary labor programs sponsored by the UAW over radio Station WJBK, Detroit, will henceforth be devoted to the Ford situation. These programs are broadcast daily.

A strike among the men building the new GM Ternstedt plant at Trenton, N. J., on Nov. 17, was settled on the following day with the loss of only half a day of working time.

In a move protested by board member Edwin S. Smith, the National Labor Relations Board has ordered an election for the 10,000 employees of the Allis-Chalmers plant at West Allis, Wis., to determine their collective bargaining union.

Workers will choose between the UAW, CIO affiliate, and one of the three craft unions, depending upon the nature of their duties. Craft unions involved are the Independent Draftsmen, the International Brotherhood of Firemen & Oilers and the International Brotherhood of Electrical Workers. The election date will be fixed later but will come some time prior to Dec. 4.

The Detroit and Wayne County Federation of Labor expelled 14 members on Nov. 18 on the grounds that they had failed to comply with the action of the Federation and had moved toward the election of the CIO candidate for the loting there. The candidate, Patrick Detroit mayorality in the recent bal-H. O'Brien, was defeated.

### Champion's British Plant

The English factory of the Champion Spark Plug Co. has been placed in full operation, President R. A. Stranahan announced at Toledo, with the expectation of a first year run of 6,000,000 plugs. Mr. Stranahan made the announcement following formal opening ceremonies at the plant near London attended, among other dignitaries, by His Royal Highness, the Duke of Kent and Sir Malcolm Campbell, holder of the world's speed records on land and water. Modern machinery and equipment have been installed under the personal direction of Charles Dewar, production manager of the American company. The English unit will supply the foreign trade formerly shipped from Windsor, Ontario. It was made necessary by the expansion of Champion's sales abroad, which now include original equipment orders from such cars as the Ford, Humber, Morris, Standard and many others.

The \$500,000 factory was built on a five-acre tract at Middlesex. The structure is one story and covers 33,000 sq. ft.

### Chevrolet Service Schools

Special supplementary training schools will be held the week of Nov. 22 throughout nearly 10,000 Chevrolet dealerships in all parts of the United States, it was announced by C. W. Wood, manager of the Chevrolet service and mechanical department. The schools are designed to supplement the training received by dealers' service and mechanical managers in the new product schools held for several weeks before the announcement of the new Chevrolet models for 1938, Mr. Wood explained. Every dealer's service man will be schooled to give full and complete service on the 1938 cars at the conclusion of the training week, he said.

## Martin Ends GM Strike

Unexpected Personal Talk  
Draws Men from Plant

An unexpected personal appeal to the 200 sitdown strikers in the GM-Fisher Body plant at Pontiac, Mich., by Homer Martin, president of the United Automobile Workers, resulted Nov. 22 in the evacuation of the plant by the strikers. It also served to avert what looked like a wide open split in the union's ranks as some of the strikers had insisted on defying the local union and the international union by persisting with the strike. Martin's plea that they live up to the original contract with General Motors brought them around to his view.

How purely accidental was the sudden ending of the strike was shown (Turn to page 768, please)

## Registrations at Peak

(Continued from page 763)

Pennsylvania with 8.2, and both Georgia and Michigan with 8.0. Eleven other states show increases of from 5 to 8 per cent, with the District of Columbia indicating a slight decline of about 1 per cent. Two states, New Mexico and South Dakota, will have approximately the same registrations as during 1936 while the remaining states will exceed last year by from 1 to 5 per cent. No one section of the country has prospered (if automobile registrations can be taken as an indicator of prosperity) in excess of any other section, nor is it the case that the industrial states have improved to a greater degree than have the agricultural.

The largest contributor to this new peak in total registrations is the sales of new motor vehicles. It is estimated that 3,640,000 new passenger cars will have been distributed throughout the country by the end of this year. In addition, about 635,000 new trucks will be operating on the highways, a new high point in new truck registrations, making a total of new motor vehicles around 4,275,000 units. However, it must be remembered that many of the vehicles that were in use last year have since gone out of service due to old age, accidents, fire, etc.

From all indications these 29.6 million vehicles are traveling, on an average, further than they did last year. Gasoline consumption for the first eight months of 1937 shows an increase over similar period of last year of about 10 per cent as against the 5 per cent increase in registrations.

The annual AUTOMOTIVE INDUSTRIES estimate of total registrations precedes by several months the definitive figures made available by the Bureau of Public Roads, Washington. The survey on which it is based is made possible by the cooperation of motor vehicle authorities in all the states and the District of Columbia. Actual registrations to date, plus an actuarial estimate for the remainder of the year give the published total for each state.

Included this year for the first time is shown the increase or decrease in new car registration for the first nine months of 1937. These give an interesting lead to determining the junking rate in all states included.

### Call Airport Conference

A conference on the subject of a national program of airport planning and other problems relating to airport size, finance, maintenance and similar subjects, has been called for Dec. 6 and 7 at the Department of Commerce Building, it was announced by Col. J. Monroe Johnson, Assistant Secretary of Commerce.

The conference, which will be composed of representatives of state, municipal and private agencies, the De-

partment of Commerce and other Federal bodies, has been called in an effort to effect an interchange of ideas and opinions of those concerned with airports and to arrive at a comprehensive and coherent national airport plan which will be acceptable to all, Col. Johnson stated.

The following have been invited to send representatives: Aeronautical Chamber of Commerce, Air Transport Association of America, American Municipal Association, Conference of Mayors, National Association of State Aviation Officials, National Advisory Committee for Aeronautics, Navy Department, Post Office Department, War Department and Works Progress Administration.

### Car Linage Up in October

October advertising lineage in newspapers fell below that for the like month of the preceding year, but topped September totals, according to *Editor & Publisher*. A gain in automotive lineage in the month was attributed to the advancement from November of the

dates of many automobile shows and to the fact that there were five Sundays in the month, against four the year before. The figures for October were 134,979,361 against 136,635,194 a year earlier, and against 117,255,950 in September, 1937. Automotive lineage was 7,755,521 in October against 6,182,923 a year earlier, and against 4,052,187 in September.

### October Car Sales Gained

New passenger car sales in October in 37 states ran 16.59 per cent higher than the same number of states in October a year ago, an R. L. Polk & Co. report disclosed.

Sales in the states reporting totaled 140,758 as against 120,727 a year ago. The figure, however, is down 15.61 per cent compared to September sales for 37 states.

New truck and commercial car sales in 37 states in October total 27,724, which is down 1.24 per cent compared to October a year ago and down 26.35 per cent compared to September sales in the same number of states.

Estimated Total Registrations (As of Dec. 31, 1937)						
	Passenger Cars	Trucks and Buses	Total Motor Vehicles		Per Cent Change	% Change, New Motor Vehicle Registrations, 9 Months 1937 over 1936
			1937	1936		
Alabama*	246,586	53,528	300,126	297,292	+ 1.0	+18.5
Arizona	102,978	22,505	125,483	115,035	+ 9.1	+ 6.2
Arkansas	170,000	56,000	226,000	217,227	+ 4.0	+ 7.9
California†	2,300,000	163,000	2,463,000	2,327,984	+ 6.0	+ 2.8
Colorado	316,200	39,100	355,300	316,050	+12.2	- 2.0
Connecticut	380,000	65,000	425,000	398,254	+ 6.8	+ 8.0
Delaware	52,500	10,500	63,000	59,629	+ 5.6	+22.0
District of Columbia	160,000	19,000	175,000	181,319	- 1.0	- 7.8
Florida	348,297	73,187	421,484	386,907	+ 8.9	+ 9.5
Georgia	364,667	76,938	443,605	410,593	+ 8.0	+13.8
Idaho	111,000	27,000	138,000	133,037	+ 3.9	- 1.8
Illinois	1,560,000	221,000	1,781,000	1,659,750	+ 7.4	+10.2
Indiana	815,000	135,000	950,000	905,088	+ 5.0	+ 8.2
Iowa	648,000	85,000	733,000	728,414	+ 0.6	- 0.5
Kansas	485,983	95,400	581,383	577,906	+ 2.2	+ 2.2
Kentucky	342,000	58,000	400,000	372,576	+ 7.4	+10.5
Louisiana	242,632	77,200	319,832	302,420	+ 6.0	- 3.7
Maine	157,670	41,735	199,355	191,554	+ 4.1	+12.1
Maryland	332,382	56,957	389,339	376,462	+ 3.0	+10.3
Massachusetts	739,811	105,019	844,830	816,711	+ 3.3	+ 4.6
Michigan	1,339,000	142,000	1,481,000	1,373,676	+ 8.0	+16.1
Minnesota	706,000	116,248	822,248	783,627	+ 5.0	+ 4.8
Mississippi	164,000	44,500	208,500	205,890	+ 1.3	+ 2.3
Missouri	693,000	129,000	822,000	809,615	+ 1.6	+ 3.8
Montana	133,728	39,800	173,528	167,150	+ 4.0	-14.6
Nebraska	355,000	62,680	417,680	413,787	+ 1.0	- 9.0
Nevada	32,500	8,000	40,500	38,509	+ 5.2	- 9.9
New Hampshire	100,000	24,000	124,000	122,236	+ 1.4	+ 4.9
New Jersey	855,645	140,930	996,575	943,412	+ 5.8	+16.9
New Mexico	85,500	23,000	108,500	106,729	None	+ 8.8
New York	2,240,000	362,000	2,602,000	2,453,542	+ 6.1	+ 8.8
North Carolina	447,000	75,200	522,200	504,517	+ 3.8	+17.0
North Dakota	142,000	32,000	174,000	187,241	+ 4.1	+ 7.3
Ohio	1,615,785	174,459	1,790,244†	1,712,051‡	+ 4.5	+10.1
Oklahoma	482,000	93,000	545,000	531,914	+ 2.5	- 3.6
Oregon	300,471	63,444	363,915	332,729	+ 9.3	- 3.9
Pennsylvania	1,780,347	296,100	2,076,447	1,918,116	+ 8.2	+13.9
Rhode Island	148,569	20,156	168,715	159,140	+ 5.8	+14.6
South Carolina	256,000	37,000	293,000	278,829	+ 5.0	+24.0
South Dakota	158,000	28,000	186,000	186,480	None	- 5.3
Tennessee	342,000	54,000	396,000	380,792	+ 4.0	+ 6.1
Texas	1,230,000	315,900	1,545,900	1,478,124	+ 4.7	+ 0.8
Utah	103,000	20,000	123,000	116,816	+ 5.5	+ 1.5
Vermont	78,000	9,205	87,205	84,155	+ 3.8	+ 7.9
Virginia	363,100	68,150	431,250	417,463	+ 3.2	+ 4.2
Washington	448,000	85,000	530,000	499,860	+ 6.1	- 1.2
West Virginia	245,019	46,280	291,299	280,015	+ 4.0	+ 0.2
Wisconsin	715,900	148,800	864,700	835,178	+ 3.5	—
Wyoming	63,000	16,800	79,800	76,603	+ 4.1	- 2.6
Total	25,355,222	4,156,721	29,511,943	28,221,291	+ 5.0	+ 7.8

\* For fiscal year ending September 30.  
† For fiscal year ending March 31, 1938.

‡ For fiscal year ending March 31, 1937.  
§ Includes some light commercial vehicles.



## Business in Brief

### Decline Progresses

The declining tendency of business appears to be gaining momentum. One estimate places the present rate of business activity at more than 12 per cent below that a year ago. Retail sales last week were from 3 to 12 per cent above those in the corresponding period last year and from 1 to 3 per cent above those in the preceding week. Wholesale trade was dull. According to an estimate by the Secretary of Commerce, holiday trade this year will be slightly better than in 1926 but about 15 per cent below the 1929 level.

Railway freight loadings during the week ended November 13 totaled 689,614 cars, which marks a decline of 42,531 cars below those in the preceding week, a decrease of 95,366 cars below those a year ago, but an increase of 59,886 cars above those two years ago.

Production of electricity by the electric light and power industry in the United States during the week ended November 13 was 0.3 per cent above that in the corresponding period last year.

### Chain Store Sales

According to the "Chain Store Age," store chain sales in October increased by less than the usual seasonal amount. The index of sales for that month stood at

114.8, based on the 1929-31 average as 100, as compared with 117.0 the month before and 109.0 a year ago.

Production of lumber during the week ended November 6 stood at 60 per cent of the 1929 weekly average. Output was 28 per cent greater than new orders and 14 per cent larger than shipments. Production and new orders were slightly below the levels in the preceding week, while shipments showed a substantial decline.

Average daily crude oil production for the week ended November 13 amounted to 3,541,450 barrels, as compared with 3,533,250 barrels for the preceding week and 3,040,400 barrels for a year ago.

### Fisher Index Off

Professor Fisher's index of wholesale commodity prices for the week ended November 20 stood at 86.1, as compared with 87.1 the week before and 87.9 two weeks before.

The consolidated statement of the Federal Reserve banks for the week ended November 17 showed an increase of \$2,000,000 in holdings of discounted bills and one of \$18,000,000 in Government securities. Holdings of bills bought in the open market remained unchanged. Money in circulation declined \$30,000,000, and the monetary gold stock remained unchanged.

employs from 2500 to 3200 men. It has been closed since Oct. 12, due to labor difficulties. The company first announced the plant would not be re-opened, but after conferences with city officials, who promised full protection for all who desired to work, the company announced the plant would be re-tooled for the 1938 models and opened as soon as possible. Most of the factory officials had been assigned to other points and they are being returned to Kansas City to aid in the work of re-opening of the plant.

### New Fruehauf Body

A new trailer body is being produced by the Fruehauf Trailer Co., Detroit, Mich. The new body, known as the "F" type, incorporates all-metal, rust-resistant roof, deformed front scroll and rear-header and special high grade steel panels. The roof is said to reflect more of the sun's rays than a canvas type, protecting the load from excessive heat. A special layer of plywood behind the panels is designed to eliminate waves in panels, and prevent rumbling, while the space between this interlining and the regular plywood lining of the body, affords insulation. In case of accident only the affected parts need be replaced. "Snap-on" moldings are used throughout, so that any panel may be removed without disturbing another, or uprights taken out from inside of the body without interfering with the panels.

## Martin Ends Strike

(Continued from page 766)

in the fact that only curiosity took L. B. Netzorg, associated with counsel for the union, for a walk near the plant after the union's executive board had ended its meeting at 9:30 a. m. Nov. 22 without accomplishing anything. Netzorg, talking with strikers at the plant, was told that some of the men felt the union officials had "run out" on them and that they wished to talk the matter over with Martin. Netzorg telephoned Martin who had just gone to bed, and Martin, without notifying the union's board of his intentions, rose and went to the plant for his successful effort at ending the sitdown strike.

End of the board meeting at 9:30 a. m. followed a discussion which had lasted from midnight. It resulted in a statement by the board that the strike was illegal, and "destructive of the best interests of our membership," but which also charged General Motors with a "studied refusal to accept its responsibility in collective bargaining with the international union, while insisting on contractual responsibility on the part of the union." This statement was issued only after a sharp dispute at the meeting, during which Wyndham Mortimer, a vice-president of the union, suggested that the strike be authorized and followed by evacuation of the plant and further negotiations with GM. He was seconded in this by Walter Reuther, president of the West Side Local. The proposal was defeated by the executive board which then issued its statement. During the board meeting, it was reported to the board that strikers were so hostile to Martin and to his associates that the board's mes-

sages to the strikers had not been delivered.

Governor Frank Murphy of Michigan stated his pleasure at the termination of the strike. It had become known through Martin that he was considering using state militia to force evacuation of the plant.

GM executives indicated that the Fisher body plant would probably reopen Nov. 29 as the intervention of the Thanksgiving holiday makes this a short week. The tieup at the Fisher Body plant forced the closing of the Pontiac Motor division's car plant at Pontiac.

The strikes at the Fisher Body plant—there were two within a few days—followed a vote by UAW plant delegates from 60 GM plants Nov. 14 against acceptance of a revised contract which company officials and representatives of the union had worked out after weeks of negotiation. The revised proposal, which GM said it understood had the approval of UAW officials did not give the union what was demanded, and was turned down by the plant delegates. A strike at the Fisher Body plant occurred on Nov. 15, the day after the vote against the proposal, and when the instigators were discharged a second strike developed into the sit-down. The Nov. 15 strike was stated by the management to have resulted from the discharge of men as the company reduced production.

### Ford Adds Men at K. C.

The Ford Motor Company plant here, which reopened Nov. 15 with a partial force of office workers and parts division men, is adding daily to the number of men employed. H. C. Doss, manager, expects to have the plant back in full operation within two weeks. The plant

## ... slants

**DRIVING IN BRAZIL**—A letter to the editor of the British magazine "The Autocar" reports on the difficulties of getting a driver's license in Brazil. By comparison with American procedure, the troubles—and the cost—are stupendous. Following is the procedure as reported by the letter-writer: Show written evidence of parentage, get an introduction to the police, have both these items notarized, have finger prints and photograph taken at the investigation department, on the following day return to the department for a certificate showing no criminal record, go to the traffic police for identity card. Then: get a certificate from a doctor that the applicant does not suffer from fits, be vaccinated by an authorized doctor, go to the traffic police for written permission for an eyesight test, take the medical documents to the treasury and pay fees, go to the municipal doctor for the eyesight test and at the same time be examined by another doctor (the physical test and application for it cannot be taken on the same day as the departments are not open at the same times), get a certificate from the local police station to verify living at the address given, go to the Directorate with all the papers and arrange for the driving tests which must be taken later. A license is needed for each car the applicant wants to drive. Certificate of authority to drive must be taken to the traffic police to get a provisional driving license, an identity card, a car license, a certificate of car ownership and the owner's permission to drive (if the applicant is the owner, he needs a letter from himself). An-



other photograph is taken and a reading test given, and in about ten days the applicant may return to get the definite license. Total cost is about \$30.

**THE ODDS MOUNT**—So says the Keystone Automobile Club when you cut out of line, pass on a hill or curve, or drive too fast. The club's statisticians have analyzed the records of 100,000 drivers and find that cutting out of line is the worst fault from the point of view of accident probability, for it raises the odds in favor of a smashup to 50 to 1. Similarly, the odds against safety at speeds of over 40 m.p.h. are put at 25 to 1, compared with proceeding at what is described as a normal pace. Passing on curves increases the chance of an accident 21 times, passing on an upgrade 10 times. Failure to give signals for stops or turns raise the chances of an accident five times, the club calculates.

**HITCH-HIKERS**—The effect of the automobile on Canada's wild life was revealed in a recent illustrated lecture in Toronto, Ont., by Dan McCowan, naturalist. Plants formerly restricted to a relatively small locale are now spreading all over the Dominion, via the mud-encrusted fenders of cars, he said. Most notable "hitch-hiker" among the plants is the dandelion. Unknown in the Rockies 15 years ago, the dandelion is prevalent on the hillsides all through the mountains now. With the common flax, another newcomer to the west, the dandelion covers the slopes with yellow. Another recent arrival is the evening primrose.

#### Pays Bonus to Workers

Ladish Drop Forge Co., Cudahy, suburb of Milwaukee, for the second time has distributed bonus checks among its 900 employees, based on earnings for the year ended Oct. 31. While the amount was not made public, it was stated that the aggregate payment was 60 per cent greater than the initial bonus paid a year ago, the increase being accounted for by greater employment and higher earning power of employees. The maximum payment was 6 per cent to those employed five years or more and the minimum one per cent to those employed less than a year.

## 40 Years Ago

with the ancestors of  
AUTOMOTIVE INDUSTRIES

#### Gasolene vs. Gas Engines

According to reliable authorities the gasolene engine is beginning to displace the gas engine in the United States. The reason for this is seen in the comparative prices of the two fuels. Gas can safely be computed at \$1.25 per thousand feet, while a thousand feet of gas can be produced from gasolene for about 80 cents. . . . Where producer gas can be used the figures would be changed considerably, favoring the gas engine in most cases.

The consumption of gas for power purposes could be enormously increased, if the gas companies would make a satisfactory rate to such consumers, but as they show no inclination to do this, the gasolene engine is filling the breach.

From *The Horseless Age*, Oct., 1897.

## Equipment Flexible

(Continued from page 764)

board will be cut to represent the various pieces of equipment. Then, if the management decides that a more efficient arrangement of machinery is desirable, the whole interior of the plant can be rearranged with little trouble.

Shutdowns will be of short duration when change-overs are made. It will not be necessary to close the plant for weeks at a time while arranging the machinery for the production of newly designed motors and axles.

Construction in Australia of a plant for the manufacture of farm implements was announced by the International Harvester Co. The new plant will be built and operated by the International Harvester Co. of Australia, Pty. Ltd., the Australian affiliate of the International Harvester Co.

The plant will be built on a 45-acre tract of land at Geelong in the state of Victoria, about 45 miles south of Melbourne, capital of Victoria. Geelong, an industrial city of about 45,000 population, is on Corio Bay, with excellent railroad connections to the north and west, and with good deep water harbor facilities. The new plant will cost approximately \$2,000,000, and will employ about 450 men. Construction is being planned so as to have the plant in operation sometime next year.

The new plant is being built for a number of economic reasons, officials pointed out. Australian agriculture requires many special types of farm machinery peculiar to that country, which it is difficult to manufacture economically in the United States in small volume. Such machinery can be made more satisfactorily in Australia.

Another factor is the growing system of Australia import duties and quotas in effect on American-made farm implements. By manufacturing parts and certain machines in Australia, the Harvester company will be able to protect its long-established business on lines of machinery it will continue to make in the United States. Still another factor is the great distance of Australia from American farm machinery factories, and the resultant freight charges piled up by such long distance transportation.

The Baker Equipment Engineering Co., manufacturers and distributors, located at Richmond, Va., announces the completion and opening of a new plant with 65,000 sq. ft. of floor space, according to President Joseph B. Baker, who is the distributor for Gar Wood hoists and bodies, Gar Wood tanks and Gar Wood Mead-Morrison winches and derricks. The company also manufactures Baker trailers, commercial and public utility bodies, and are distributors for other associated truck equipment.

#### NSPA Admissions

Fifteen applicants for membership in the National Standard Parts Association were admitted at the membership and executive committee meeting in Detroit, Nov. 15.

Manufacturers admitted, with convention

delegate, were: The Dushane Co., Inc., Detroit, Mich.; O. Wilton Carman; Electro Products Co., New York, N. Y.; P. O. Stewart; Ferodo and Asbestos, Inc., New Brunswick, N. J.; W. D. Dodge, Jr.; Quincy Compressor Co., Quincy, Ill.; J. T. Condor; The Shaler Co., Waupun, Wis.; W. S. Colos; J. W. Speaker Corp., Milwaukee, Wis.; J. W. Speaker.

## Company Earnings

#### Caterpillar Tractor

Reported net income for October of \$550,572 against \$763,721 for the same month of last year. For ten months the net income was \$9,686,508 against \$7,736,190 in the first nine months of 1936.

#### Michigan Bumper

Reported for the eight months ended Sept. 30 of \$133,018 including extraordinary and non-recurring losses of \$122,882. Operations of the Oldberg Mfg. Co. were included for the period.

#### A. O. Smith

Reported net income for the twelve months ended Oct. 31 of \$877,048 or \$1.76 a share. The results did not include controlled or affiliated companies' results. For the preceding twelve months there was a net profit of \$438,145 or 88 cents a share. For the fiscal year ended July 31, the company reported net income of \$16,555 against \$862,659 or \$1.73 a share for the preceding fiscal year.

#### Special Dividends

Bullard Co. declared \$1.25 on the common stock, compared with three quarterly payments of 25 cents each this year. The company will also pay bonuses ranging from \$5 to a week's salary.

Campbell, Wyant & Cannon Foundry Co. declared a special dividend of 25 cents and ordered distribution to employees of an extra \$50,000.

Douglas Aircraft Co., following earlier official indications, announced that no dividend would be paid for the fiscal year to end Nov. 30 because of the need of preserving working capital.

At a special meeting of the board of directors of the Commercial Credit Co. the quarterly dividend of \$1.00 per share and an extra, or special, dividend of \$1.00 per share were declared on the common stock, and the regular quarterly dividend of \$1.06¼ per share was declared on the 4¼ per cent cumulative convertible preferred stock for the quarter ended December 31, 1937. Desiring to recognize the efforts of the officers and employees of the corporation and its subsidiaries who are in good standing, the directors declared a special compensation amounting to one month's salary for those full time employees who are on the payroll as of December 15, 1937, and who have been continuously on the payroll since December 31, 1936. For those employees who were placed on the payroll of the company between January 1 and July 31, 1937, and who are in good standing as of December 15, 1937, a special compensation of one-half of one month's salary was voted.

Boeing Airplane Corp. declared an initial dividend of 40 cents a share.

McCord Radiator & Mfg. Co. declared a dividend of one share of funding stock, an issue recently created, on each class A share, clearing up dividend arrears on the class A which will total \$19.50 a share at the end of the year.

#### New "Veedol" Products

Tide Water Associated Oil Co., through John D. Collins, vice-president in charge of retail sales, announced five new products and a new merchandising program for the company's own service stations throughout the eastern United States. The new products are packaged in the modern manner and in sizes most convenient for the uses of the average motorist. All carrying the trade name of "Veedol," the five new items are a pre-wax car cleaner, an auto paste cleaner, an auto wax, a combination cleaner and polish and a new all-purpose household oil.

## Automotive Metal Markets

*Some Signs of Improvement Begin to be Reported in Steel;  
Lower Prices Seen Possible if Labor Costs Come Down*

There has been no marked change in the steel market's sallow complexion, but here and there forerunners of returning health are noted. Some of the finishing mills, catering chiefly to automotive consumers, report that the decline in releases has run its course and appears definitely to have come to a halt.

Production rates in some of the steel-making districts also make a slightly better showing, although the turn in the ingot production rate for the entire country has not yet set in. Some buying of sheets by Ford is looked for before the end of the month. This should help tide over some of the smaller finishing mills until there is more broadening in the demand. The steel industry, as a whole, does not look for more than mild improvement over the remainder of the year.

It is thought that one of the useful by-products of the prevailing inertia might be a more reasonable attitude on the part of labor, which would permit costs to be adjusted to prevailing conditions and make possible sufficient of a revision of selling prices to quicken the momentum of buying. Most of the steel producers are of the opinion that price concessions at the present time would be futile as a means of bringing out business, but a good many believe at the same time that when demand begins to reassert itself, the buying pace can be accelerated through somewhat lowered prices. Such reductions, in their opinion must, however, be predicated on lowered costs and not on sacrifices of profit margins, and labor has it within its power to make the greatest contribution toward a healthy revival of activity, once the present inertia gives way to the necessity of replenishing semi-finished reserve stocks that now are permitted to dwindle without thought of replacement.

Tardiness in pig iron buying by automotive foundries is in part attributed to the belief held by some purchasing agents that lessened demand for steel-making will greatly increase the tonnage available to foundries. This motive for foundry iron buyers biding their time seems rather far-fetched when they have obviously nothing to gain from anticipating their requirements because blast furnaces have reaffirmed their current quotations for the first quarter of 1938.

Non-ferrous metals continued to yield ground under the influence of speculative sentiment in the security markets. Straits tin was offered at the beginning of the week at 41 cents, with buyers few and far between. The Navy Department took advantage of the attractive price at which tin is selling, and contracted for a small tonnage of Grade A for January shipment at

the equivalent of 40.70 cents, net and delivered. Much of the blame for the spectacular swings in the tin market is being placed on the Singapore smelters, who are charged with gambling with the tin of actual producers.

After the "export price" for copper had hovered several days at around 9½ cents, one custom smelter cut his domestic quotation to 10¾ cents, whereupon the market as a whole accepted 11 cents as the current price. When copper was quoted at 12 cents, there was virtually no demand. Some metal is reported to have been taken at 11 cents.

Record-breaking exports of aluminum from Canada in the first 10 months of the year, when shipments exceeded 80,000,000 lb. compared with 58,000,000 in the entire year of 1936, went chiefly to England and Japan, U. S. takings having been relatively light. The market for secondary aluminum is lower, No. 12 alloy having been marked down ¼ to ½ a cent.—W. C. H.

Minor concessions in cadmium prices are reported.

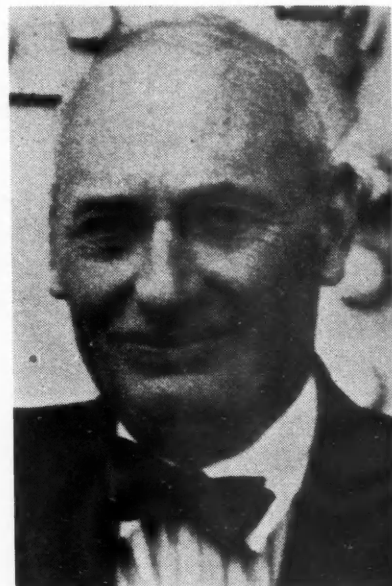
Declines in London prompted zinc producers here to lower their price by \$5 a ton. Demand is light. Lead rules dull.

### Howard E. Coffin Dies

*Well Known Engineer, 64, Passes  
at Sea Island*

Howard E. Coffin, for many years actively associated with the automobile industry as an engineer and executive, was found dead in his apartment at his winter home on Sea Island, Ga., on Nov. 21. Death was caused by a gunshot wound. A hunting trip had been planned for the next day.

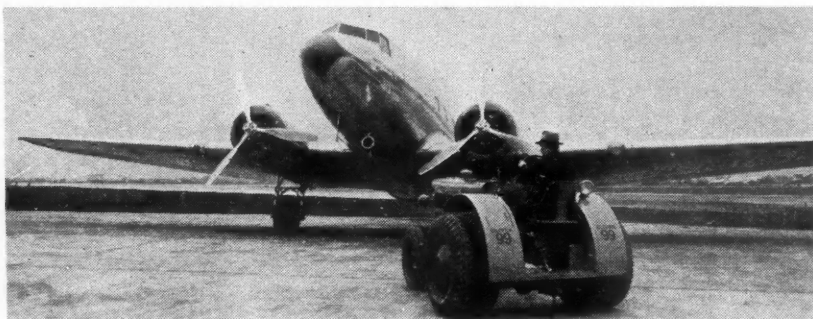
Mr. Coffin, 64 years old, became identified with the automobile industry in 1902 when he took the position of chief of the experimental department of the



HOWARD E. COFFIN

Olds Motor Works of Detroit and Lansing, Mich. In 1905, he assumed the post of chief engineer of the E. R. Thomas Detroit Co. From 1906 to 1908 he was vice-president and chief engineer of the company when he became vice-president and consulting engineer of the Chalmers Motor Co. He remained in that position until he took a similar one with the Hudson Motor Car Co. in 1910 and is still a consultant for the Hudson company.

By 1925, his interest in aeronautics brought him the presidency of National Air Transport, Inc. He had been a member of the Naval Consulting Board of the United States since 1915, and during the War, in 1917 and 1918, he was a member of the Advisory Commission of the Council of National Defense. Mr. Coffin was actively identified with the National Aeronautic Association for many years, of which he was president in 1923, and he belonged to the Aero Club of America, the Engineers Club of New York and other organizations. He also served as president of the Society of Automotive Engineers.



### ON THE GROUND

planes are handled by tractors. The Oliver Far Equipment Co. will soon deliver 60 of them to American Airlines for use in moving ships around at the airports. Illustrated is an Oliver "99" special industrial tractor.

The care with which the planes must be handled is indicated in the fact that some of the hangar doors allow only a foot or so of space outside the wingspread. The planes have a gross loaded weight of 24,000 lb. 8"x tires are used on the Oliver units for traction.



## Production Cut

(Continued from page 763)

5,050,000 cars and trucks will have been assembled for the full year 1937.

—H. E. G.

Customer deliveries of Cadillacs and LaSalle's in the first 10 days of November showed an 86 per cent increase over the comparative period of a year ago, General Sales Manager D. E. Ahrens reported. Sales charts disclosed 1016 cars delivered against 545 during the first 10-day period of 1937. In October customer deliveries reached 3115 cars, the best volume since 1929, compared to 1110 cars a year ago.

"The record was accomplished despite the fact that our dealers are still far from adequately stocked with 1938 models," he said. "This is especially true of the new Cadillacs. Manufacturing operations, however, are being stepped up and within a few weeks we expect to be getting the production necessary to meet the immediate heavy demand for these series."

The Buffalo plant of the Ford Motor Co., closed for about two months, resumed operations at about 50 per cent of capacity on Nov. 22, according to an announcement by William L. Yule, district manager. Approximately 1200 men were called back to work with the plant maintaining a starting schedule of 200 cars a day until the capacity basis of around 400 cars a day is reached.

### ATA Elects for Coming Year

Officers of the American Trucking Association re-elected for the coming year include: Ted V. Rogers, president; H. D. Horton, W. H. Brearley, John W. Blood, C. S. Reynolds, vice-presidents; L. A. Rauerson, treasurer; Chester G. Moore, secretary. Divisional vice-presidents, and D. H. Megginson, oil field equipment haulers; H. N. Sheridan, cartage operators; Walter F. Cary, automobile haulers; John F. Winchester, private carriers.

Twelve new officers were elected including vice-presidents Fred O. Nelson, Jr., J. P. Spoonhower, H. H. English, H. Ward King, Walter Mullady, Jos. E. Edell, W. P. Fuller; divisional vice-presidents: James P. Clark, film carriers; James B. Godfrey, Jr., common carriers; Sam Ziffrin, contract haulers; Merle Fullerton, household goods; Chas. Yokum, petroleum transporters.

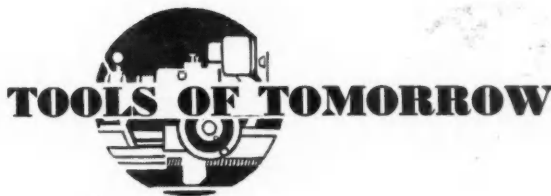
### Buick Magazine

Announcement was made by Thos. H. Corpe, director of advertising and sales promotion of the Buick division of General Motors, that total subscriptions to the Buick Magazine, a publication circulated to Buick owners throughout the country, now stand at 600,000 copies monthly, the largest subscription list since the magazine was inaugurated three years ago. Mr. Corpe said the October issue, in which announcement of the new 1938 cars was carried, totaled 1,076,806 copies.

### Huber Heads Ex-Cell-O

Phil Huber, vice-president and assistant general manager of the Ex-Cell-O Corp., and one of its original organizers in 1919, was elected president and general manager at a meeting of the board of directors Nov. 23. He succeeds N. A. Woodworth, who resigned because of ill health. H. G. Bixby, assistant secretary since 1929, and controller since 1932, was elected secretary-treasurer and a director.

Automotive Industries



### Transmission

... new unit provides wide range of speeds; ratio over 45 to 1.

Wide speed variation is a feature of a new transmission unit recently placed on the market by the Speedmaster Co., Minneapolis. Standard vee-belts which run over adjustable Bakelite pulleys are used in the device. In the transmission illustrated herewith, the output shaft runs at 90 r.p.m. at the slow



Speedmaster transmission with output shaft speeds ranging from 90 to 4300 r.p.m.

speed and 4300 r.p.m. at the high speed.

Alignments between pulleys and belts is automatically maintained throughout the entire range of the variable speed ratio adjustment.

The device is being used successfully in such machines at the Doall contour machines in which this "Speedmaster" transmission is standard equipment.

### Boring Bar

... heavy duty unit can be handled by one man.

What is claimed to be the first heavy duty boring bar capable of taking large cuts at high speed, yet easily handled by one man, has been produced by the Van Norman Machine Tool Co., Springfield, Mass.

When equipped with a ½ hp. capacitor type motor that turns up 3,400 r.p.m., this new bar is said to be capable of boring or sleeving any block from a 60 hp. Ford of 2.600 in. diameter up to and including one of 5 11/32 in. Two speeds and two feeds make it possible to take large cuts for sleeves.

### Thread Generator

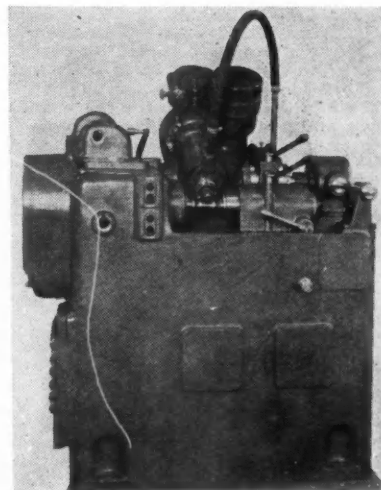
... new type machine for cutting hourglass steering worms.

A new type of hourglass thread generator for cutting hourglass steering worms has recently been placed on the market by the Fellows Gear Shaper Co., Springfield, Vt. This machine employs a cutter head of the swinging type.

It is intended for high-production work and is arranged with automatic electric control. It is also designed for quick removal and insertion of the work. Rigid design of this equipment and the method employed for presenting the cutter to the work are said to make possible the production of accurate and smoothly-finished worm threads at a rapid rate.

The work is customarily held between cones, one on the stub driving arbor in the headstock and the other on the tailstock center. The cutter is kept in step with the threads on the work through feed gears and is fed down directly into the work, the rate of feed per revolution being governed by the rise on the feed cam, in conjunction with feed gears. The depth feed cam is provided with a depression which allows the cutter head to be automatically elevated when the

(Turn to page 788, please)



Fellows machine for cutting hourglass steering worms.

November 27, 1937





## AUTOMOTIVE ABSTRACTS

### Building Up by Steel Spraying

The metal-spraying process originated by Schoop in Switzerland has been known to industry for about a quarter of a century, but in the past it has been confined mainly to the spraying of non-ferrous metals or metals which do not oxidize readily at high temperatures. In recent years it has been found possible also to build up iron and steel parts with sprayed steel deposits, and the process in consequence is finding new applications in industry.

At the recent S.A.E. regional transportation meeting in Newark one of the authors mentioned that in the fleet-maintenance operation under his control, bearing parts of worn crankshafts are ground down and then built up by spraying alloy steel on them. A similar development has taken place abroad, and the spraying of steel was covered in a paper by Richard R. Sillifant at the meeting of the (British) Iron and Steel Institute at Middlesbrough in September. This paper, moreover, described experiments with different fuels for melting the wire and with different inert propelling gases to surround the molten metal with an atmosphere that prevents its oxidation.

In the application of the spraying process, use is always made of a pistol which is in reality a combination of two elements, viz., a mechanism for feeding the wire at a predetermined speed into the second element, which latter consists of means for melting, "atomizing" and impelling the resultant particles of metal. The mechanical element, known as the wire-feed mechanism, comprises an air-actuated turbine which drives a pair of wire-feed rollers through a series of reduction gears. The second element, known as the "gas head," is composed of a needle valve for regulating, firstly, the air for driving the turbine, and, secondly, the oxygen and fuel gas used for melting the wire, together with a series of ports, gas and air channels for mixing the oxygen and fuel gas and for conducting air to atomize and impel the molten metal. All of these parts are mounted on an aluminum case attached to a suitable handle or grip. Wire-fed pistols are designed normally to use either coal gas, hydrogen or acetylene as the fuel gas burned. The cost of operation is usually the controlling factor, for which reason coal gas is used in most commercial plants.

An improved deposit of steel and its alloys can be obtained if oxidation of the sprayed metal particles can be prevented. In the spraying process oxidation can occur in four distinct phases, namely (1) in the flame zone, if this contains excess oxygen; (2) when the molten metal is removed from the tip of the wire by the air blast; (3) on the surface of the sprayed article by exposure of the metal particles to the air blast and to the atmosphere; and (4) if the sprayed article becomes excessively heated. By using a strictly neutral flame and keeping the work cool, causes (1) and (4) are eliminated, and the main cause of oxidation then is the air blast on the nozzle. To keep this reducing, insufficient fuel for the amount of air must be supplied, and it was found that with such lean mixtures of coal gas or hydrogen the flame was not steady, while with dissolved acetylene it was. Nitrogen from pressure bottles was used as an inert propelling agent.

A markedly improved structure was indicated by a microphotographic study. The oxide inclusion in the sprayed structure was so small that it did not prevent diffusion of carbon from the core into the coating. Because of this diffusion, all traces of a junction between the two metals had disappeared. Further, the coating had commenced to resolve into a definite crystalline structure.

Recrystallisation of the deposit and the temperature which will effect it depends on the calescence and recalescence points of the particular steel used, and these depend, in turn, upon the amount of carbon present. Thus, a steel having a high carbon content will have a lower calescence point and will recrystallise at a lower temperature, and in a shorter time. It is believed that in this way a form of casehardening can be effected without carburisation, since a high-carbon steel could be applied to a machine element by spraying, be refined by heat treatment, and then be reheated and quenched to obtain a hard surface. Thus the deposit would have the advantages conferred upon it by spraying, namely, abrasion resistance and oil-retaining properties due to slight porosity, coupled with homogeneous bonding to the base and a refined structure.

The question of adding known deoxidising agents, such as silicon, aluminium, magnesium, &c., to the wire itself is being considered, and an alternative to the use of compressed inert gases by way of deoxidising the air on commercial lines by static chemical means capable of regeneration forms the subject of present experiments. As far as the carbon diffusion from the base metal to the coating is concerned, it is assumed that the higher the carbon content in the base material, the greater will be the absorption of it into the coating. Cast iron, therefore, when coated with a steel deposit and heat-treated, should give so much carbon to the deposited steel as to make it extremely hard, without further treatment. Thus, in effect, a means of providing cast-iron parts having frictional or other bearing surfaces with a hard homogeneous layer of wear-resisting metal is indicated.—*Engineering*, Nov. 5.

### Early History of the Diesel Engine

On Oct. 4 the fortieth anniversary of the first practical success with the Diesel engine was commemorated at the Augsburg Works of the M.A.N. Co., where the first engines were built. In an address by Director Meyer of the firm it was brought out that Diesel in 1892 applied for a patent on an internal combustion engine that represented an attempt to practically apply the principle of the Carnot cycle. After the patent was issued, Diesel approached the Augsburg Machine Works, a predecessor of the M.A.N., with the proposal to build an engine in accordance with it. At that time the Machine Works could not see its way clear to agree to the proposal. Diesel then gave evidence of that pertinacity which finally enabled him to see his plans carried through, and issued a pamphlet entitled "Theory and Design of a Rational Heat Engine as a Substitute for the Steam Engine and Present-Day Internal-Combustion Engines." As he himself admitted later, comments on the contents of this pamphlet for the most part were very unfavorable and in fact disheartening.

Diesel then approached the Augsburg Machine Works once more, and in spite of its earlier unfavorable attitude, the latter now agreed to carry out his proposal. In October, 1892, even before a written contract had been signed, the first design was completed. A regular contract was signed in February of the following year, and during the same year Diesel made a similar arrangement with the Krupp Works. It was then arranged between Krupp and Augsburg that development work should be carried on at Augsburg. When the original design was submitted for approval, it was immediately discarded in favor of a new plan of Diesel's, and a second engine was designed and built under his personal direction. It was to have operated in exact accordance with the principles laid down in the pamphlet. In order to avoid operating difficulties, however, it was decided to use gasoline or kerosene as fuel.

This machine was built in 1893 and the tests began on June 17 of that year; they were abandoned after 38 days, when it was found impossible to get the engine to run under its own power.

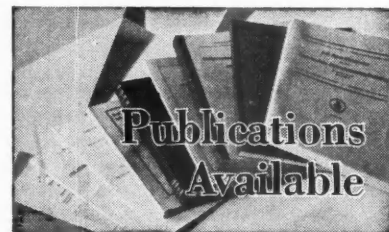
Drawings were then made of an entirely new engine, in which the cylinder and head were water-cooled and the fuel was injected by means of compressed air. This engine was completed in Jan., 1894, and on Feb. 17 of that year it ran under its own power for the first time—without load for one minute. It was found impossible, however, to get power from this engine. On March 26, 1895, tests were begun on a third engine, and it did not take long before this engine could be idled. On June 26, of that year the first brake test was made, and showed a thermal efficiency of 16.6 per cent, with a kerosene consumption of 0.84 lb. per b.hp.-hr.

On the basis of the experience with this engine, another engine was designed, and was completed in October, 1896. Trial runs in December of that year led to some changes in the method of fuel injection. Additional tests in January, 1897, proved entirely successful, and on Feb. 17, 1897, Professor Schröter of Munich Technical College issued the results of an acceptance test made for a purchaser, which indicated a thermal efficiency of 26 per cent and a specific fuel consumption of 0.517 lb. per b.hp.-hr.

Many further difficulties had to be overcome after the engine was placed in practical use, but the claim that the high compression would result in unprecedented fuel economy had been proved and interest in the new engine had been aroused throughout the world.—*ATZ*, Oct. 25.

### Old Cars Numerous

Over 40 per cent of the automotive passenger cars and 56 per cent of the trucks in operation in Czechoslovakia are over seven years old, according to official statistics made available in Prague and made public by the Department of Commerce. It was also announced that there are 101,736 cars listed in operation in Czechoslovakia.



The OK Tool Co., Inc., Shelton, Conn., has issued its catalog No. 11 covering holders and tool bits, milling cutters and parts, and counterbores, boring heads, reamers, etc., with a revised price list. The company has also published two folders, one on tee slot bolts and the other on inserted-blade metal cutting tools.\*

Two bulletins, describing the No. 6T-Type hourglass thread generator for cutting steering gear worms, and the Nos. 3-48 and 3-60 rack shapers, have been issued by the Fellows Gear Shaper Co. The bulletins contain operating data.\*

The Niagara Machine & Tool Works has issued a new bulletin, "H", illustrating and describing the company's Series H Power Squaring Shears added to the line.\*

W. F. and John Barnes Co. has published a circular covering the Barnes Gear Pump.\*

E. F. Houghton & Co., has issued a booklet describing the properties and applications of its Sta-Put extreme-pressure lubricants.\*

The Laminated Shim Co. has issued a bulletin describing aircraft manufacturing applications of the product.\*

\*Obtainable from editorial department, AUTOMOTIVE INDUSTRIES, Address Chestnut and 56th Sts., Philadelphia.

## Letters

### to AUTOMOTIVE INDUSTRIES

#### High-Mounted Tail Lights

Announcement of the first 1938 cars reveals a possible trend in design which, without presenting anything significant in the way of functional advantage, may possibly introduce a hazard which has not been pointed out, as far as I know. I refer to the practice first introduced in 1937 of mounting tail (and stop) lights high on the rear quarter.

My first reaction to the idea, before encountering such lights on the road, was that it was a logical and clever idea in design. Unquestionably it is possible to make such lights blend in with body lines at least as well as when they were fender-mounted, and, of course, they are less likely to be damaged. Still further, it simplifies the replacement or refinishing of fenders when they are damaged.

On the other hand, I have observed on those occasions when driving behind cars so equipped, that their tail lights are very close to eye level. This would doubtless be cited by the proponents of such lights as an advantage. It is my opinion, however, that it is a hazard, since their brightness (especially if the stop light is operating) makes them a point of distraction which impairs the ability of the eye to see objects beyond and to the side of the car ahead.

The present concern with the matter of headlights and road illumination at night should carry with it a realization that the human eye has a considerable strain imposed on it by having to observe objects under very low conditions of illumination. Under such conditions the object having the greatest intensity of illumination has probably the greatest attention value—involuntarily if not voluntarily. When a relatively bright object is interposed practically in the line of vision of objects which it is desirable, if not imperative to observe, the result should be evident to even those persons who have not studied psychological optics.

It does not seem to me that this objection to the high mounting of tail lights is at all offset by possible arguments that the lights are more effective warnings of the presence of the vehicle bearing them. A pair of adequate tail lights, mounted definitely below eye level, should be entirely adequate for that purpose.

HERMAN P. ROTH,  
Boston, Mass.

#### MEMA Elects 4 Directors

The Motor & Equipment Manufacturers Association announces the election of the following as members of its board of directors for the three-year term of 1938-1939-1940.

D. S. Brisbin, vice-president, Columbus-McKinnon Chain Corp., Tonawanda, N. Y. Mr. Brisbin was a member of the first MEMA board of directors, in 1932.

R. C. Brower, secretary-treasurer, The Timken Roller Bearing Co., Canton, Ohio. Mr. Brower's company was a charter member of the former Motor & Accessory Manufacturers Association, organized in 1904, since which year the company has been a member of the MAMA, the MEA and the MEMA.

R. D. Pippen, assistant treasurer, American Hammered Piston Ring division of Koppers Co., Baltimore, Md. Mr. Pippen will be the MEMA board member representing the MEMA credit department board of governors.

F. W. Swanson, president, Globe Hoist Co., Des Moines, Iowa.

#### Tire Output May Rise Jan. 1

Goodyear Tire & Rubber Co. officials have indicated that they hoped production might be stepped up after Jan. 1. The Goodyear Plant No. 2, which confines most of its production to passenger car tires, did not re-open with the balance of the factory Nov. 22, officials advising that, because of a dearth of current orders, it would remain closed for at least a week. This plant has been operating only an average of two days weekly.

Goodyear has slackened production in its new tire plant at Jackson, Mich., and has suspended tire production in its Gadsden, Ala., tire plant until Dec. 7. The production ticket at Gadsden had been about 10,000 tires daily.

With crude rubber prices still weak and every major tire company facing a heavy year-end inventory write-down unless crude rubber prices stiffen substantially before Dec. 1, Goodyear, like other manufacturers, is seeking to liquidate its finished goods inventories as much as possible before the end of the year.

#### Pontiac Dealer Profits

Pontiac division of General Motors Corp. reports that the 4,000 and more dealers' net profit for the nine months ended Sept. 30 was \$3,982,970 or 47.2 per cent greater than in the like period of 1936, making their net profit for the period approximately \$12,417,000 or approximately \$3,100 per dealer.

The Pontiac report stated that new car retail sales were 173,858 and used

## Books

### of automotive interest

*A Survey of the Development of the Automobile Radiator*, by John Coltman, M.A. Printed by Whitehead Brothers, King Street, Wolverhampton, England.

This is a reprint in book form of a paper originally presented before the Midland Branch of the Institution of Mechanical Engineers. It deals with the theory of heat transfer in simple, non-mathematical language, describes and illustrates the various types of radiator core in use, and discusses problems of installation and use. The book also deals with aircraft and rail-car radiators and the use of radiator cores for oil cooling and for heating purposes. One chapter is devoted to "Plants and Tests for the Investigation of Radiator Problems" and the readable little volume concludes with a bibliography.

car sales were 407,553 units, making 581,411 cars handled or about 14.5 cars per dealer.

The report stated that part of the increase in the aggregate net profit of the dealers was due to an increase of 157 in the number of dealers but that the average dealer made 41 per cent more than in the preceding year.

Fixed expenses per \$1,000 of new car sales dropped \$13 in the face of an increase of approximately \$1,500,000 in higher salaries, wages, commissions, rent, supplies, etc.

## Calendar of Coming Events

### DOMESTIC SHOWS

Kansas City, Mo., Automobile Show,  
Nov. 27-Dec. 4  
A.S.I. Show, Navy Pier, Chicago,  
Dec. 6-Dec. 11

### FOREIGN SHOWS

Montreal, Que., Automobile Show,  
Nov. 20-27  
Peru, Automobile Show, Lima,  
Dec. 23-Jan. 6, 1938

### CONVENTIONS AND MEETINGS

American Standards Association, Annual Meeting, New York City....Dec. 1  
MEWA Annual Convention, Chicago,  
Dec. 3-4  
American Society of Mechanical Engineers, New York .....Dec. 6-10  
Exposition of Chemical Industries, New York .....Dec. 6-11  
SAE National Production Meeting, Flint, Mich. ....Dec. 8-10  
American Engineering Council, Annual Meeting, Washington, D. C.,  
Jan. 13-15, 1938  
SAE Annual Meeting, Detroit,  
Jan. 10-14, 1938  
American Road Builders' Association, Cleveland .....Jan. 17-21, 1938  
American Society for Testing Materials, Spring Regional Meeting, Rochester, N. Y. ....Mar. 7, 1938  
SAE National Passenger Car Meeting, Detroit .....Mar. 28-30, 1938

#### France Not To Raise Duties

No increase in import duties on American cars is contemplated by France, according to an inquiry made in official Paris circles. In Government quarters the impression appears to be that the French automobile industry has all the protection it needs by reason of the devaluation of the franc a year ago, followed by the drop in the value of the currency during the last six months. It is because of this that the export bonus was not renewed in 1937.

Despite devaluation, the French industry has not increased its exports to an appreciable extent. During the past 12 months car prices have increased on an average nearly 25 per cent, and some of the leading makers are about to announce a further 5 per cent increase which probably will be followed by a second 5 per cent in a couple of months. These rising costs have had a restrictive effect on exports.

In the Government probe of national production, the official dealing with automobiles was critical of French manufacturers. The makers shift the blame onto the Government program of a 40-hour week, increased salaries, paid vacations and, for a time, the encouragement given to sit-down strikers.

# Automotive-Gear Design



Fig. 1—This is a 1937 sliding gear shaft with a lapped involute spline on the shaft and a broached and re-broached splined hole in the gear.

By R. S. DRUMMOND\*

**T**HE history of the development of automobile transmissions shows a tendency to depart from the time-honored conventional theories of gear design and to adopt entirely new principles based upon intensive experiment and service history.

Today the tendency is to reduce diametrical pitch and increase tooth length beyond conventional limits, these changes being accompanied by an increase in the helix angle of helical

gears and a decrease in pressure angle.

What has been the cause of this revolutionary change in practice? As far back as 1910, it became popular to shorten the teeth so as to approach conventional stub-tooth design. This idea spread for many years and was unchecked until service failures of a basic nature made it clear that the stub-tooth form was the very thing that induced gear-tooth noise and reduced the service life of hard-working automotive gear units. It became evident that although the stub-tooth materially increased resistance to bending, the design sacrificed other and much more

valuable properties. Thus it was learned that the stub-tooth form produced a very serious overloading, resulting in gouging and surface pitting, which led to failure. This is due to the smaller area of contact and relatively poor distribution of load due to the lack of carry-over from tooth to tooth, imposing serious overloads on the tooth tips.

The stub-tooth and other conventional practices, which had worked with ordinary gear trains, were inadequate to meet the needs of the high velocity and relatively highly-stressed automotive units. And the greatest weakness of such designs lay in the fact that their proponents failed to appreciate the im-

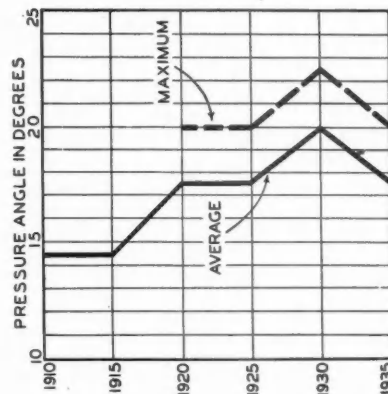


Fig. 3—Pressure angles for passenger car transmission gearing from 1910 to 1935 inclusive.

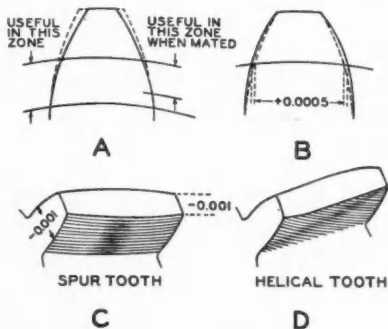
portance of wear resistance and endurance, which today are recognized as exceeding that of resistance to bending.

With this introductory background, let us consider some essentials of current practice.

## Helix Angle

In the main, transmission design has abandoned the straight spur form in favor of the helical tooth. This change was made in the first place because of the emphasis upon "silent" gear sets. However, experience soon proved that the helical gear has many other virtues. Most important is the greater life of such gears, due to increased overlap, and easy approach and recess of contacting lines. Because of this, the early designs took advantage of steeper helix

Fig. 2—Group of drawings illustrating some fundamental features of modern gear design. "A" indicates the extent to which the involute profile may be modified in practice. "B" shows the principle of rounding involute profile at the pitch line with thickness at the pitch line increased about 0.0005 in. "C" and "D" indicate the possibilities of improving performance by crowning the face of both spur and helical gears.





# Demands Modern Methods

angles, until they reached a maximum value of 60 deg. With time, however, there has been a gradual decrease from this limiting value, and today the generally-accepted view is that the helix angle should be between 30 and 40 deg.

## Pressure Angle

Some time ago there was a general tendency to design spur gears with constantly increasing pressure angles, until a limit of 20 deg. had become an accepted value. With the introduction of helical gears, it was found more advantageous to use smaller pressure angles and, in fact, the angle was progressively reduced, in some instances to as low as 12 deg.

However, even with helical gears it became the vogue for a time to increase the pressure angle to as high as 30 deg. It will be recalled that such gears were given proprietary trade names, and treatises were published as to their benefits. True, these gears were found to be of some value in special applications, such as gear pumps, but today their general use has been abandoned, in favor of the smaller pressure angle.

Tooth breakage on low-pressure-angle gears, which was experienced in the earlier stages, was attributed to weak root sections. However, it proved to be caused largely by inaccurate processing. In present-day practice, where tooth-index error and profile are held within limits of less than 0.0005 in., making possible even distribution of loads, such failures have been eliminated.

It is considered good practice today to use pressure angles ranging from

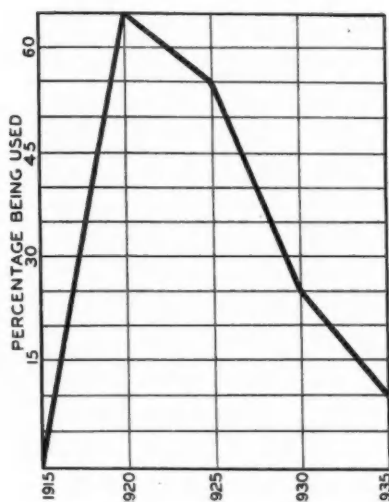


Fig. 6—Trend of stub tooth gears in passenger car transmissions from 1915 to 1935 inclusive.

12 to 17 deg. in helical gears, and from 14 to 20 deg. in spur gears. However, knowing the pendulum swings that are just as common among engineers as they are in other walks of life, it may be suspected that designers will attempt

to experiment with smaller and smaller angles, but ultimately they will swing back to the normal range of 12 to 20 deg.

## Diametral Pitch

Formerly it was considered good practice, in motor cars of any considerable size, to use 6 D.P. teeth, and a few manufacturers insisted upon 5 D.P. When smaller D.P.s. were tried, 7 and 8 for example, it was found that the gears gave better wear for blanks of about the same diameter.

Moreover, as the practice of using smaller pitches with a correspondingly greater number of teeth spread more widely, it was found that longer life was obtained. In fact, some cars have been operated on test runs with gear teeth as fine as 16 D.P. Others have tried designs with extra long teeth, around 16/14 pitch, so as to get greatly-increased tooth-to-tooth carry-over. It must be remembered, however, that the limiting factor on tooth length is that of tooth land; a sharp edge cannot be tolerated, and, in general, it is beneficial

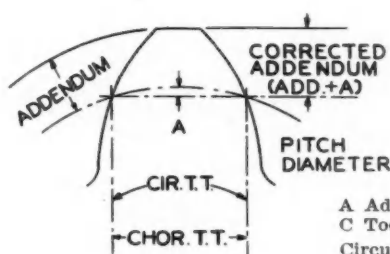


Fig. 5—Corrections for gear tooth calipers.

A Addendum correction  
C Tooth thickness correction  
Circular tooth thickness given  
Chordal tooth thickness CIR. T.T.-C

## SPUR GEARS

$$(CIR. T.T.)^2$$

$$A = \frac{4 \times P.D.}{A}$$

$$C = \frac{\text{No. Teeth}}{A}$$

## HELICAL GEARS

$$(NOR. CIR. T.T.) \times (\cos. \text{HELIX ANGLE})^2$$

$$A = \frac{4 \times P.D.}{A}$$

$$C = \frac{\text{No. Teeth}}{A}$$

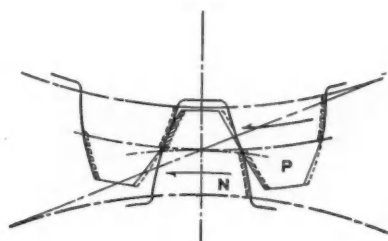


Fig. 4—Packard practice is an excellent illustration of how existing knowledge may be used to modify tooth form. This drawing shows how a section of the addendum (under dotted area) is removed so that the first contact of the region at "P" takes place below the pitch line at "N."

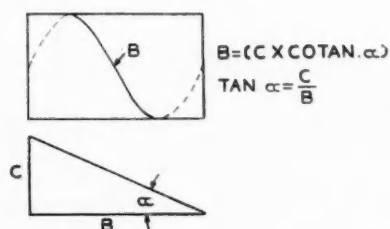


Fig. 7—Spiral angles at different diameters.

#### USEFUL PROPORTIONS

$$a_1 = \text{H.A. AT-}D_1$$

$$a_2 = \text{H.A. AT-}D_2$$

$$\text{TAN. } a_2 \quad D_2$$

$$\text{TAN. } a_1 \quad D_1$$

#### EXAMPLE

Spiral angle of 30° is known on pitch diameter which is 3.000  
Spiral angle to be found is (0.010) below pitch diameter or on 2.980 diameter

$$C = 3.000 \times 3.14159 = 9.42477$$

$$C = 2.980 \times 3.14159 = 9.361968$$

$$\text{Tan. } a =$$

$$\frac{9.361968}{16.32417} = 0.573503 = 29^\circ 50'$$

$$a = \text{Spiral angle}$$

$$B = \text{Lead}$$

$$C = \text{Circumference pitch diameter.}$$

to have a minimum land of 1/16 in. on the top of the tooth, for gears up to 8 in. in diameter and 1 in. width of face.

Manufacturing difficulties have precluded the immediate adoption of 16-pitch gears in transmissions, and the industry as a whole has found it desirable to compromise on more reasonable sizes. Judging by present practice, it is likely that much of the volume of production will feature pitches ranging from 10 to 14, rather than the old standard of 7 or 8.

#### Tooth Profile and Form

Experience has further modified the conventional involute profile. For a time it was the habit of designers to specify modifications at the tops of all mating gears, and this reached the point where teeth no longer contacted on the upper surface. To all intents and purposes, it would have been just as logical to cut off the entire top of the tooth, right down to the starting point of the modification.

Recent practice has introduced the rounding of the involute profile at the pitch line, making the formation at the pitch line about 0.0005 in. thicker than conventional, but holding the thickness at the tip and bottom within conventional limits. This minute but positive rounding has a marked effect upon quietness of operation, by relieving the teeth of the sudden impact upon entering and leaving contact.

Another rather novel modification is the crowning of the face of the tooth at each end, so that the chordal thickness at the center is slightly greater than at the ends. This avoids the objectionable edge contact between gear teeth as occasioned by errors in gear manufacture or due to misalignment at

assembly. Crowning is recognized as being of great benefit, particularly when the reduction of chordal thickness does not exceed 0.0001 in., since most of this space is filled with an oil cushion when under load. When treated in this manner, the gears have no tendency to load up on their ends, and, consequently, they exhibit greater strength and wear resistance.

An excellent example of current practice is that of Packard Motor Car Co., whose transmission gears are so designed that they will not contact until they approach the center line between shafts. To this end, the addendum on each mating gear is removed—on one side—as shown in Fig. 5. The first contact at point P will occur approximately on the line C-C<sub>1</sub>, and will continue down the tooth face N. The area of contact is bounded by the double line, the lower portion of tooth P and upper portion of N having no contact when moving in the direction indicated.

A similar situation prevails when rotating in the opposite direction. To achieve these results, Packard increases the carry-over of tooth contact by using

a 46-deg. helix angle, 10 D.P., and about 14-deg. pressure angle. These elements, combined with the modified profile N, produce a practically-silent gear train.

#### Timing Gears

Quiet timing-gear trains for automotive engines are recognized as a factor of great value in modern practice. Many improvements have been made to this end, including the introduction of an elastic molded-composition idler gear, better alignment of gear centers, close clearances, and improvement in tooth profile.

Without going into further details, I am listing below a few of the controlling elements as dictated by good current practice:

1. Large number of teeth with small D.P.
2. Use of long-addenda and long-dedenda teeth
3. Use of helical rather than straight teeth
4. Use of rounded involute profile, as described earlier, with increased thickness at pitch line ranging from 0.0002 and 0.0003 in.
5. Relief of gear tooth edges so that the chordal thickness at the center exceeds the chordal thickness at the edges by about 0.001 in., as described above.

By utilizing these scientific principles, the designer will be able to produce inherently quiet gear trains.

#### Involute Splines

The involute spline for transmission mountings is a relatively new feature of design; it merits attention here because it demands the same consideration as the modern gear and lends itself to the same principles of design and production techniques as have been discussed in the foregoing.

The use of involute splines instead of the conventional straight-sided spline offers several advantages. In the first place, it is much easier to fit two curved surfaces than two flat surfaces. This

(Turn to page 788, please)

Fig. 8—Maximum outside diameter of mating gears without interference.

$B_1$  = Radius of maximum outside diameter of pinion without interference.

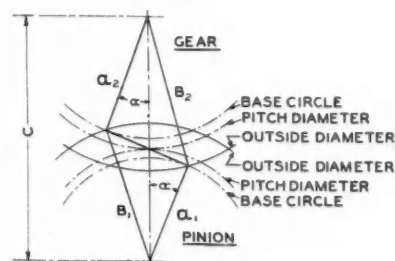
$B_2$  = Radius of maximum outside diameter of gear without interference.

$C$  = Center distance.

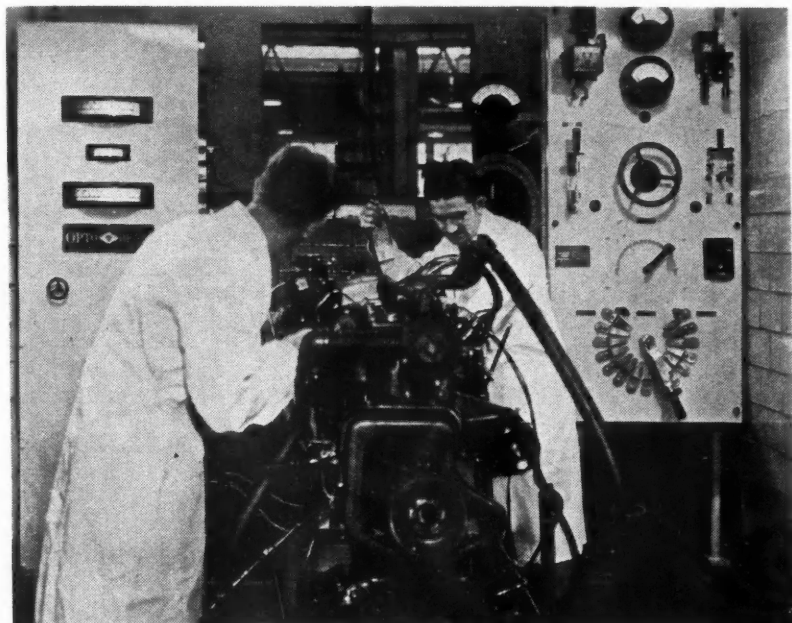
$a$  = Pressure angle in degrees.

$$B_1 = \sqrt{(a_1)^2 (C \sin a)^2}$$

$$B_2 = \sqrt{(a_2)^2 (C \sin a)^2}$$







(Left) View in the Chrysler dynamometer room showing Opto-Beam instruments on left-hand panel

(Below) Close-up of Opto-Beam instruments

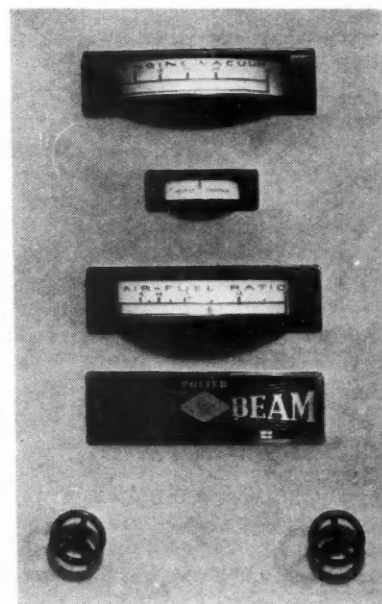
## Opto-Beam Checks Engine Adjustments at Chrysler

**C**HRYSLER MOTORS CORPORATION in its Chrysler division has recently installed eleven Opto-Beams for checking the adjustments of engines before they are installed in chassis. The Potter Opto-Beam is an automatic instrument which indicates the vacuum existing in the inlet manifold (which is taken with the engine idling), and analyzes the exhaust gases and gives an indication of the fuel-air ratio of the mixture that is supplied to the cylinders by the carburetor. It is stated that the optimum inlet-manifold vacuum for an idling engine is of the order of 21 in. of mercury. If the vacuum is materially greater, the engine will idle irregularly, whereas if it is much less, the engine will be sluggish in operation.

Adoption of the Opto-Beam as a service accessory for Chrysler dealers is said to have been directly responsible for its introduction at the factory. Immediately the dealers began to use these instruments, they discovered many faults which had passed the

rather elaborate checking system at the factory, and it was decided that the only way to prevent such occurrences was to do the factory checking also with these instruments. At present the Chrysler engine plant puts limits of 20 and 21 in. of mercury on the vacuum which the engine must show at idling speeds before it can be passed. Inlet-manifold vacuum is affected by many adjustments, the variables influencing it including valve action, valve timing, spark plugs, spark-plug cables, compression, intake manifold leaks, exhaust back pressure, carburetor adjustment, engine friction, and engine lubrication. The instrument, of course, will not show what is wrong, but if the vacuum is within the set limits it is said to indicate that all of the factors which affect it are correct.

Each of the eleven Opto-Beams is installed in a separate dynamometer room, and the vacuum test and exhaust gas analysis are performed at the same time as the regular dynamometer tests. Each of the dynamometer rooms



is finished in bright-colored tile, and has attractively painted instruments boards and conveyors for handling the engines. The tests require so little time that engine production is not slowed down thereby. The dynamometer rooms are operated by mechanics in white coats, and the general effect is much the same as that of a modern kitchen or dairy.

The exhaust-gas analysis made by the apparatus is translated by it into terms of air fuel ratio, which is indicated by a pointer moving over a dial. A mixture ratio somewhere between 12.5 and 14 is said to give the best results.

By E. W. SEAHOLM\*

**P**RIOR to 1938, the Cadillac Motor Car Division produced eight, twelve and sixteen-cylinder automobiles in the highest priced group. Since the total sales volume in this field is necessarily limited, a simplification was indicated. Also development of the Cadillac V-8 engine had progressed to the point where its power development was almost equal to that of the twelve and, in power-to-weight ratio and general efficiency, the eight was superior to both the twelve and sixteen. To realize the twofold purpose of model simplification and improved engine design, the production of an entirely new model to supersede both the twelve and sixteen-cylinder lines was decided upon; this model was to have a modern engine based upon the principles which had proven successful in the V-8.

Our ideas as to the characteristics desired of the new automobile were well defined at this time, hence we knew, in a general way, what was required of its power plant which might be specified by the following aims:

(1) The engine should have more than eight cylinders and should develop as much power as the current sixteen.

(2) It should be reduced in length as compared with either the current twelve or sixteen.

(3) It should be lighter in weight than either the twelve or sixteen.

(4) The engine should be more economical to produce than the current sixteen and should be simple to service.

(5) In addition to the above special requirements, the engine must, of course, meet the high standard of performance and serviceability required of high priced automobiles.

\*Chief Engineer of Cadillac Motor Division, General Motors Sales Corp.

### Type of Engine

The first decision to be made was the choice between a twelve or sixteen-cylinder power plant. Sixteen cylinders were chosen principally because of the inherently greater smoothness of this design. Also increased durability was indicated for the sixteen since it would have a shorter stroke and less piston travel. Increased manufacturing expense and increased complications were objections to the greater number of cylinders. We believed, however, that we could develop a simplified design in which sixteen cylinder advantages would be realized in an engine having actually fewer parts than either the Cadillac sixteen or Cadillac twelve then in production. The final design justified this belief.

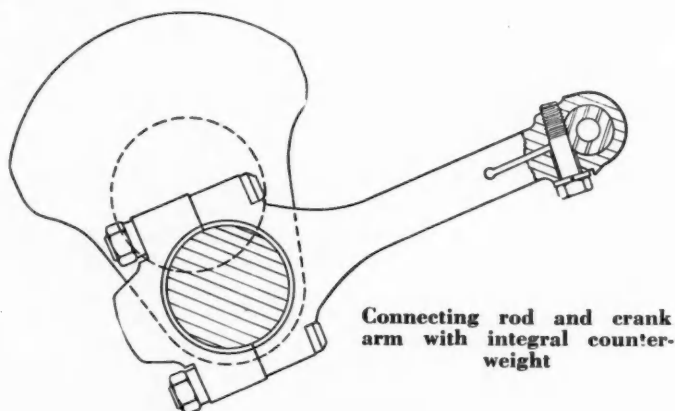
Next came the decision as to vee angle. We wanted an angle giving uniformly spaced power impulses because they give the minimum variation of gas pressure torque, making for low speed smoothness and also give zero inertia torque variation necessary to high speed smoothness; in a sixteen-cylinder engine the zero torque variation is of much greater importance than variations of gas pressure torque. Another advantage of equal firing intervals is that they require less energy

absorption in the torsional vibration dampener which permits reduction of the weight and size of this unit.

In a V-16 engine two vee angles give equal firing intervals, 45 deg. and 135 deg. (excluding inverted designs). The Cadillac sixteen-cylinder engine then in production employed a 45 deg. angle. This was the logical design to accommodate its two manifolding systems with updraft carburetors disposed on the outsides of the two blocks. In this engine the valves were in the head since the narrow vee did not provide space for side valves.

Since simplification was one of our aims, we favored L-head combustion chambers and side valves operated by one camshaft in the center of the vee. The wider 135 deg. vee angle was,

## The Evolution of



Connecting rod and crank arm with integral counterweight

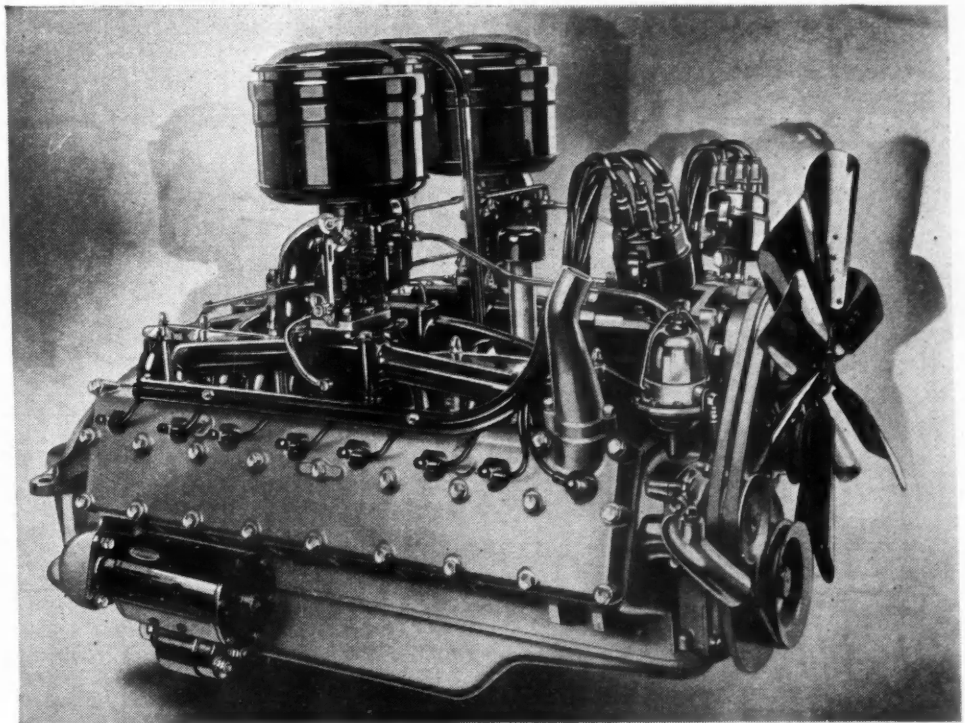
therefore, desirable for space requirements of the side valves. Since a sixteen-cylinder engine of the desired size would have a stroke of not over four inches, the wider vee angle also was desirable in providing more length between cam and valve head.

The wider vee angle provided more space for the manifolds and downdraft carburetors. The wide angle reduced engine height but increased width. There was, however, no objection to the width increase so long as this was not above a certain amount. As soon as we had decided upon the wider vee angle, the limitation of engine width became a secondary argument for the use of side valves, the greater depth of the valve-in-head design being prohibited with the 135 deg. angle.

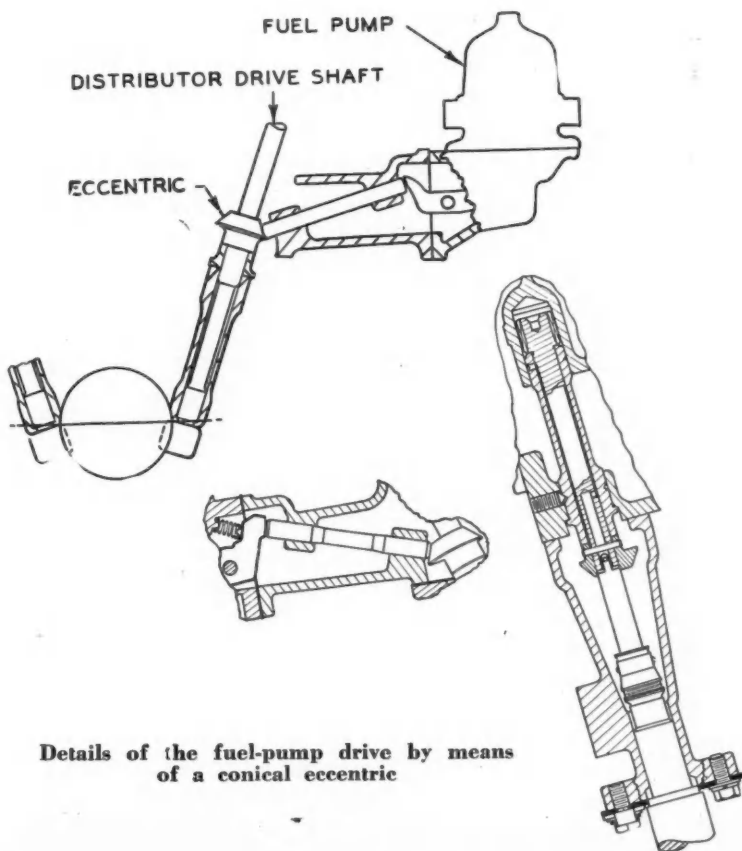
Foundry practice had advanced to the point where no serious difficulty was anticipated in casting both cylinder blocks and the crankcase in a single unit. Such a design naturally would be more compact. It later developed that the enbloc iron casting was also lighter even when compared with the former designs which had aluminum alloy crankcases. The single casting



General view of the new Cadillac 16-cylinder engine with dual accessories



## the Cadillac Sixteen Engine



Details of the fuel-pump drive by means of a conical eccentric

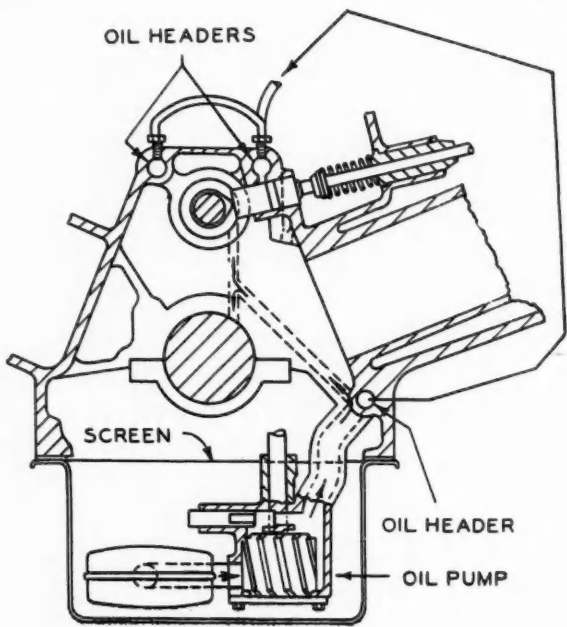
was more economical to produce since there were fewer parts to handle and fewer surfaces to machine. It was more rigid, avoiding cylinder bore distortion and increasing smoothness in operation, and was of advantage from the service standpoint because it reduced oil leakage by reducing the number of gasketed joints. In combination with the wide vee angle the enbloc casting made possible the short stroke employed in the final design.

### Design

The weight of the vehicle had been estimated and the power requirements determined from which we fixed the required engine size at about 430 cubic inches. Other factors such as bore and stroke, type of crankshaft and bearing sizes were determined by laying out four alternative designs as indicated by Table 1.

These preliminary layouts indicated that engine No. 1 was the shortest but that No. 4 was almost as short and would be narrower and probably lighter.

Rotating and reciprocating weights were estimated for the four engines and connecting rod bearing loads and



On left: Details of lubrication system

crankshaft bending stresses calculated. The results showed that engine No. 4 because of its short stroke and short, light connecting rod had the lowest connecting rod bearing pressure-velocity factors. Its larger bore caused a higher rod bearing load due to gas pressure but this was thought of small importance since high gas pressures occur only at low speed. Tests were made which proved the higher gas pressures did not reduce bearing life. In regard to crankshaft stresses, engine No. 4 also compared well. Its nine main bearings obviously would have lower pressures than would the five equal sized bearings of the other designs.

Other factors influenced us in choosing engine No. 4. Its short stroke reduced the height, width and weight of the engine. The short stroke was also desirable, of course, from the standpoint of low piston speed which

improves durability and oil economy. At the axle ratio used (4.31 to 1) the piston travel in feet per mile for the four engines would be as follows:

Engine No.	1	2	3	4
Piston Travel—				
ft. per mi..	1870	1715	1590	1590

**Crankshaft, Rods and Pistons**  
The nine bearing crankshaft was re-

garded as desirable for this engine because:

(1) As previously shown, the combination of a nine bearing shaft and short stroke gave the most compact design.

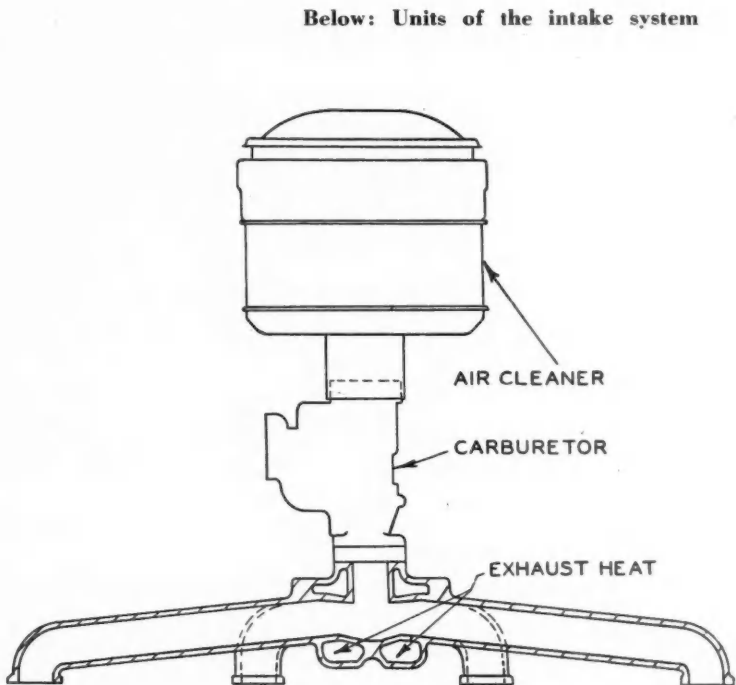
(2) The two inch diameter crankpin of the nine bearing shaft permits withdrawal of the rod through the bore.

(3) Drilling of the crankshaft for oil feed to the crankpin bearings is simpler.

(4) The larger number of bulkheads increases crankcase stiffness.

The final crankshaft design has eight integral counterweights. Each of the eight crankpins, which are in the usual 2-4-2 arrangement, carries two side-by-side connecting rods. A rubber torsional vibration dampener is included in the belt pulley assembly at the front of the engine.

Because of the short stroke, the connecting rod length is only 6 3/8 inches although a ratio of rod length to stroke of almost 2 to 1 is maintained. Removable steel backed babbitt lined bearing shells are used. The wrist pin is locked in the rod, broached grooves in the piston wrist pin bearings col-



Below: Units of the intake system

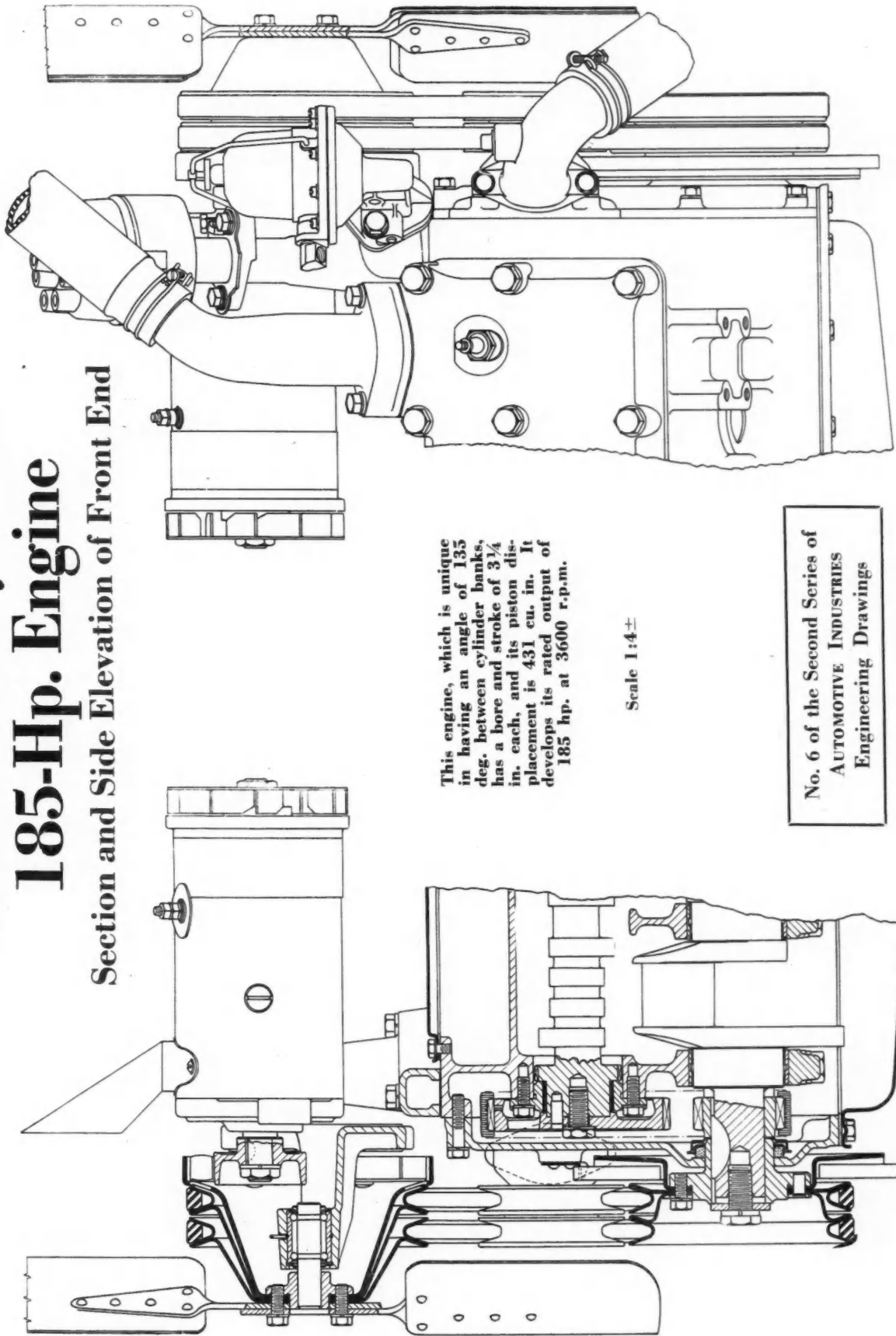
Table 1

Engine No.	1	2	3	4
Bore .....	3	3 3/8	3 1/4	3 1/4
Stroke .....	3 3/4	3 1/2	3 1/4	3 1/4
Displacement .....	424	429	431	431
Number of main bearings .....	Five	Five	Five	Nine
Main Bearing Size ..	2 1/2 x 1 1/8	2 1/2 x 1 1/8	2 1/2 x 1 1/8	2 1/2 x 1 1/8
Conn. rod bearing size ..	2 1/4 x 7/8	2 1/4 x 7/8	2 1/4 x 7/8	2 x 7/8
Conn. rod length.....	7	6 1/2	6 1/2	6 3/8
Crankshaft cheek thickness .....	23/32	23/32	23/32	19/32
Bore centers.....	3 3/4 & 4 1/4	3 7/8 & 4 1/4	4 & 4 1/4	4
Center distance of outer bores .....	27 3/4	28 1/4	28 3/4	28



# Cadillac 16-Cylinder 185-Hp. Engine

Section and Side Elevation of Front End



This engine, which is unique in having an angle of 135 deg. between cylinder banks, has a bore and stroke of  $3\frac{1}{4}$  in. each, and its piston displacement is 431 cu. in. It develops its rated output of 185 hp. at 3600 r.p.m.

Scale 1:4±

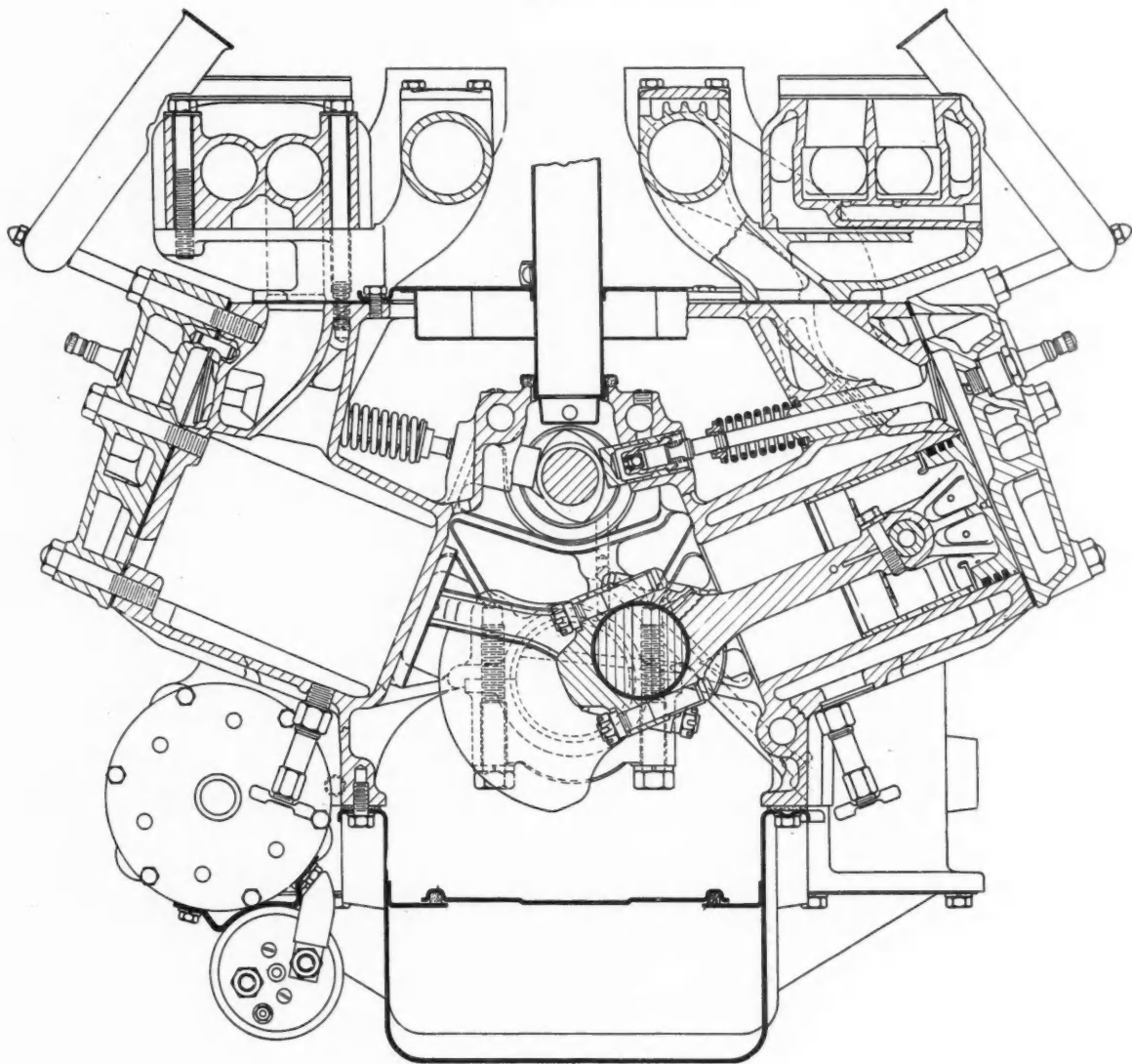
No. 6 of the Second Series of  
AUTOMOTIVE INDUSTRIES  
Engineering Drawings

# Cadillac 16-Cylinder 185-Hp. Engine

## Transverse Section

Both cylinder banks and the major part of the crankcase are in a single casting. Water jackets extend the full length of the cylinder bores. Connecting rods are unusually short, because of the short stroke, and this makes the whole engine very compact. Note the large overlap on the main journals and crankpins in the transverse section. The crankshaft is supported in nine bearings, and two connecting rods have bearings on one crankpin side by side. All oil passages are drilled in the block and the pressure oiling system extends to the camshaft bearings. Piston pins are clamped in the connecting-rod small ends and have their

bearings in the piston bosses. A rubber-type vibration damper is mounted on the forward end of the crankshaft, and this and the fan and generator drive by double V belts and a friction roller mechanism are clearly shown in the sectional view of the front end on the back page. An advantage of the large angle of V is that it permits of mounting most of the accessories on top or in the V, where with modern types of front ends of cars they are more accessible than at the sides of a narrow V engine. Another feature of this engine is that practically all accessories are in duplicate. Two dual downdraft carburetors are fitted.





lecting oil from the cylinder wall for wrist pin lubrication. The pistons are T-slotted Lo-Ex alloy anodized; each has two compression and one oil ring all above the wrist pin.

#### Crankcase and Cylinder Block Casting

As previously stated, the crankcase and the two eight-cylinder blocks are cast in a single unit. The crankcase has seven ribbed bulkheads which, with the front and rear walls, support the nine main bearings. The five camshaft bearings are in alternate bulkheads. Cylinder heads are cast iron. Machining the combustion chambers all over avoids compression pressure variation between cylinders. All intake ports are siamesed, exhaust ports are single.

#### Valve Gear

The camshaft, supported upon five bearings, is mounted in the center of the vee directly above the crankshaft, and is driven by a silent chain at the front of the engine. The cams operate mushroom type tappets which embody hydraulic valve silencers of the same type which have been used in the Cadillac eight. Two removable valve chamber covers placed across the top of the engine vee alley enclose the mechanism.

#### Lubrication System

Engine lubrication is of the force feed type. Oil is drawn from the pan through a float type intake by a helical gear pump which contains a by-pass type of oil pressure regulator valve and is located at the oil level at the rear of the engine. From the pump the oil passes to a longitudinal header within the crankcase and running its full length. Drilled passages connecting with the header and passing through each of the engine bulkheads supply the main and connecting rod bearings. The camshaft bearings are lubricated by passages which connect with the previously mentioned main bearing supply passages. The timing chain and all accessory drive gears and bearings are positively lubricated.

From the main oil header in the side of the crankcase, pipes lead oil through the filter thence to two longitudinal headers drilled in the crankcase on either side of the camshaft. Oil from each of these headers passes to the hydraulic valve silencers, lubricating them and providing the pressure necessary for the automatic valve lash adjusting action.

#### Engine Accessories

Because of the modern trend toward high fender catwalks, it was believed desirable to locate the engine accessories (which, on any engine, require

service attention more frequently than the engine itself) on the top of the block where they could be reached more readily than at the sides. The 135 deg. vee angle helped in this endeavor.

#### Fuel System

To assist service, it was felt desirable to use commercial eight cylinder accessory units wherever possible: a four-barreled carburetor or a sixteen-cylinder distributor might frighten a mechanic unused to sixteen-cylinder engines, but he should experience no difficulty in servicing standard eight cylinder parts. Development along these lines led to duality of most accessory units. For example, the two conventional fuel pumps feed the two 1½ inch dual downdraft carburetors and the two manifolding systems. The pumps, of the usual link driven diaphragm type, are mounted one on each side above the engine in front. From the right hand fuel pump a pipe leads to the right-hand carburetor while the left-hand pump similarly supplies the left-hand carburetor, the two lines are interconnected, however, so either pump may supply both carburetors.

There are two oil bath air cleaners, each mounted directly above its corresponding carburetor. From each of the two carburetors the fuel mixture passes

haust to the left hand side of the engine from which the exhaust system leads it downward and to the rear.

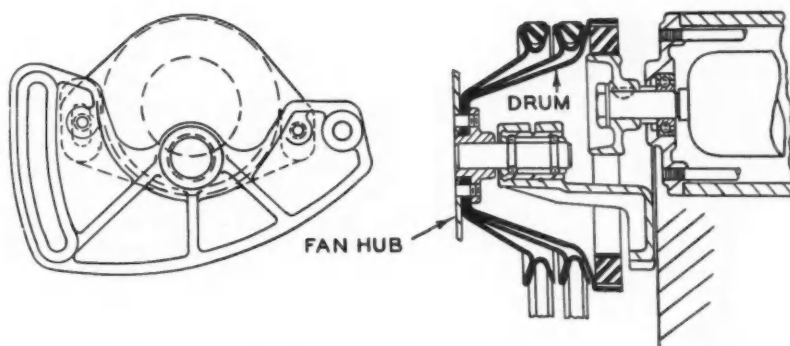
#### Ignition System

Similarly, the duality of engine accessories includes the ignition system which has two ignition coils, one providing high tension current for each cylinder bank. There are two distributors at the front of the engine driven by a single gear integral with the camshaft.

In order to simplify spark timing synchronization of the two-cylinder blocks, the timing of both coils and for both blocks is regulated by one distributor—the left hand one. This distributor has two breaker arms, each of which makes and breaks the primary current for one coil and one-cylinder bank. The rotor in this distributor handles high tension current to the left block only. The right-hand distributor contains no breaker mechanism. Its rotor distributes high tension current from the right-hand coil to the right-cylinder bank.

#### Cooling System

There are two cooling systems independent of each other except for the radiator. Each of the two radiator bottom tank outlets is connected to one



Fan and generator drive and belt-tension adjusting means.

downward to an exhaust heated division chamber thence to the four legs of each of the two dual cast iron intake manifolds, which are designed so that no two successively firing cylinders of a bank draw from the same manifold leg. All intake ports are siamesed. The exhaust ports are single, the two center ports of each cylinder block connecting directly to that portion of the exhaust manifold which heats the intake manifold division chamber. The two exhaust manifolds discharge into a cross pipe placed just behind the carburetors; the pipe conducts the ex-

haust of the two centrifugal water pumps mounted in the front ends of both cylinder blocks. The pumps have a carbon block and rubber seal requiring neither lubrication nor adjustment. From each pump the water passes rearwardly into distributing tubes extending the full length of each cylinder block; the tubes direct sprays of water around the valves, and also assure uniform distribution. The cylinder block water jackets are full length. The fan has seven asymmetrically spaced blades.

An interesting water pump feature (Turn to page 790, please).

# Waukesha Engine Uses Propane

A MARKET survey made by Waukesha Motor Co. in 1933 revealed a very definite demand among the railroads for a new power source to operate refrigeration compressors in connection with the air-conditioning of railway passenger cars. It led to the development of the Waukesha mechanical compression system (referred to as the Waukesha Ice Engine), which was dealt with in a paper by L. W. Melcher, manager, Refrigeration division, Waukesha Motor Co., recently read before the S.A.E. Milwaukee Section. The following information regarding this system is taken from Mr. Melcher's paper.

What the railroads required was an independent, self-contained unit which should be economical, reliable, quiet, and fully automatic in operation, and which would meet the requirements of the underwriters and Bureau of Explosives with respect to safety. Waukesha had had considerable previous

experience in motorizing railway passenger cars for branch line service, and also had manufactured electrically operated air-conditioning and refrigerating equipment for railway service, consequently it was rather familiar with some of the problems involved.

One of the first problems attacked was that of the most suitable fuel for the purpose, and the choice fell on propane. It belongs to the family of hydrocarbon compounds commonly found in natural gas and offers a number of definite advantages for use in internal combustion engines, as follows:

(1) At atmospheric pressure it remains in a gaseous state down to minus 51 deg. Fahr.

(2) It may be compressed to a liquid state for concentration and easy transportation, or storage. One hundred lb. of propane is the equivalent of 10,000 lb. of ice for air-conditioning purposes, and a standard three-tank supply provides the Ice Engine with enough fuel for a run from Chicago to the Pacific Coast.

(3) It possesses all the advantages of natural gas as a universal fuel, due to its uniform composition, high ther-

## *Model FC modified to operate compressors for air-conditioning of railway passenger cars*

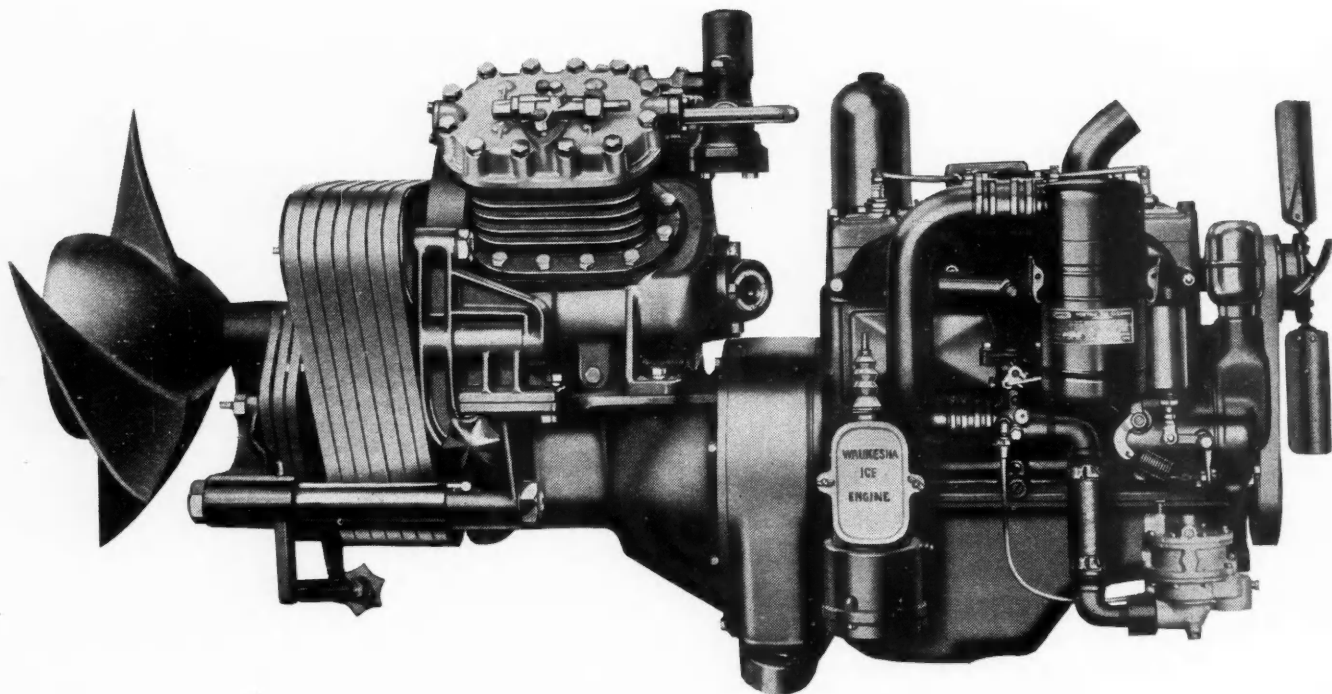


Fig. 1—Waukesha ice engine out of cabinet



Fig. 3—Ice engine rolled out and cover removed for inspection

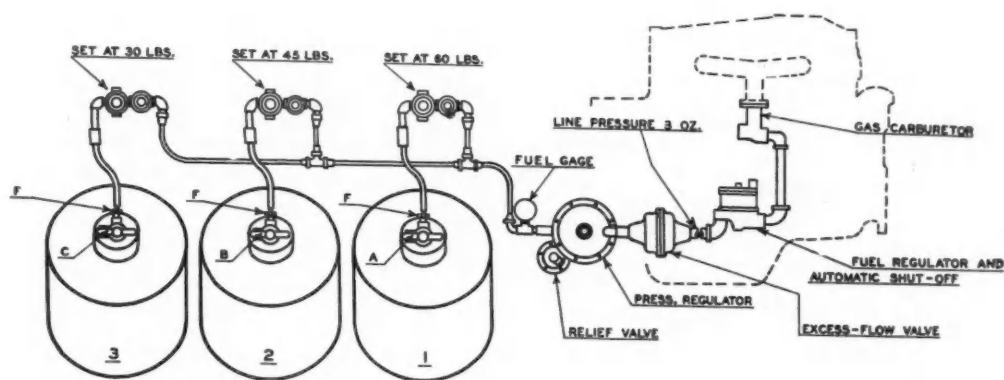
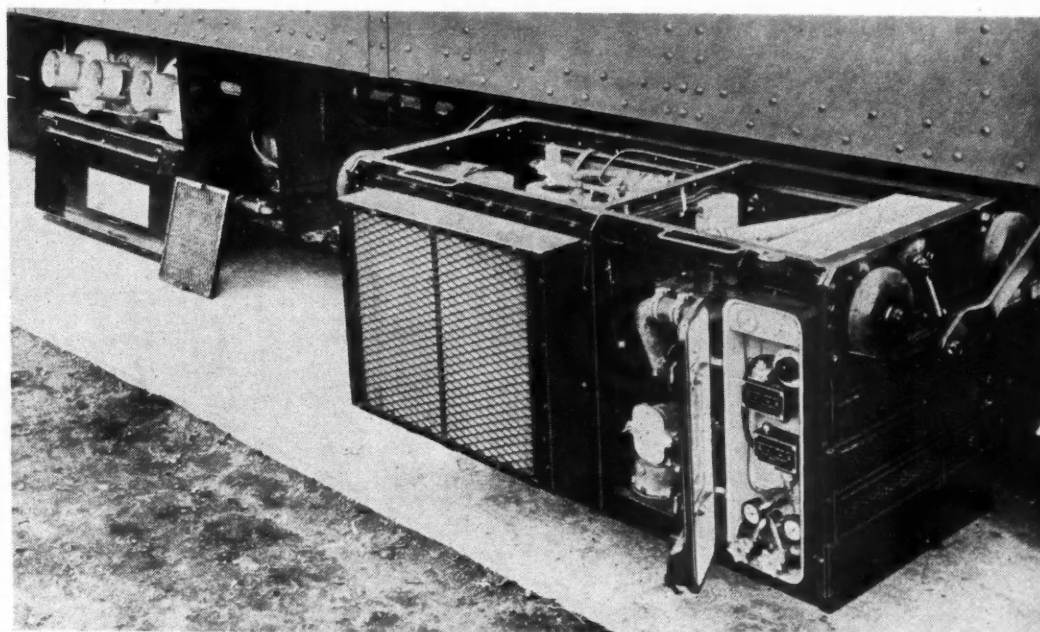


Fig. 2—Three-tank propane fuel supply valved to assure sequence unloading of the cylinders

mal value, and favorable physical characteristics.

(4) It has an octane rating of 125, permitting compression ratios as high as 10 to 1, which results in high fuel efficiency and complete combustion (unobjectionable exhaust).

(5) It is delivered to the engine as a dry gas, which reduces crankcase dilution and carbon deposits to a minimum. It is not uncommon to operate a Waukesha Ice Engine on propane for 750 hours with a single oil change, which is equivalent to one oil change on a motor truck in 22,500 miles, figuring with an average speed of 30 m.p.h.

(6) It is ideal for automatic operation, since it provides a uniform and automatic source of supply under all conditions and requires no carburetor choking for starting purposes.

The fuel system used with the Wau-

kesha Ice Engine is produced in one-, two-, three-, and four-cylinder cabinet sizes. Consecutive unloading of the cylinders is provided for by means of pressure-relief valves with definite settings of 60, 45 and 30 lb. per sq. in. Naturally, the 60-lb. valve unloads first, and so on. A second gage indicator indicates which cylinder is supplying the fuel, so that the maintenance organization knows which cylinders are empty and should be replaced.

Automatic and manual shut-off valves are provided in the manifold. The line pressure is reduced from three to six ounces, and an excess flow valve is provided, so that if more than 100 cu. ft. of gas is allowed to pass the valve, the latter closes automatically. The purpose of this, of course, is to provide an automatic shut-off in case the flexible fuel line to the unit is severed.

Each cylinder contains a main shut-off valve with an automatic check valve which will not permit any discharge of gas from the cylinder unless the flexible hose connecting the cylinder to the manifold is in the correct position. Vapor is drawn off the top of the fuel, so that no liquid enters the manifold, and a standard fuel regulator with an automatic shut-off, plus a gas carburetor, is included in the fuel supply.

In developing this system the rules of the Interstate Commerce Commission, the Bureau of Explosives, and the Fire Underwriters Laboratories had to be adhered to, and all of these organizations have given the system its approval.

The engine and compressor are housed in a single cabinet which is removable for inspection or maintenance and is lined with a 1-in. layer of

sound-absorbing material and mounted on cushion wheels. These cushion wheels, in addition to insulating mechanical noises from the car, permit easy removal of the unit from the car.

Referring to the sectional view, Fig. 5, the cushion wheel consists of rubber of two different densities. The center soft section has a durometer hardness of 12 to 15 on the Shore "C" scale, whereas the surrounding harder section shows 80 to 85. The hard section gives the required strength and rigidity, while the soft section provides the resiliency necessary to cushion impacts. Small pneumatic tires were fitted in some of the earlier installations, but these proved unsatisfactory because of the great effect of atmospheric temperature variations on the inflation pressure.

As shown by the illustration of the ice engine removed from its cabinet, it consists mainly of a four-cylinder engine driving a V-type compressor. The engine is a Waukesha Model FC, modified to operate with a compression ratio of 8.8, which is permitted by the use of propane. It is equipped with a governor and has a speed range of 750 to 1300 r.p.m.; it also has a modulating device for controlling the speed within this range in accordance with the cooling demands, and an oil-type air filter and slide switch for automatic operation. Mounted on the bell-housing is a compressor support, and an extension of the engine crankshaft drives the compressor and condenser fan. This fan moves air through the

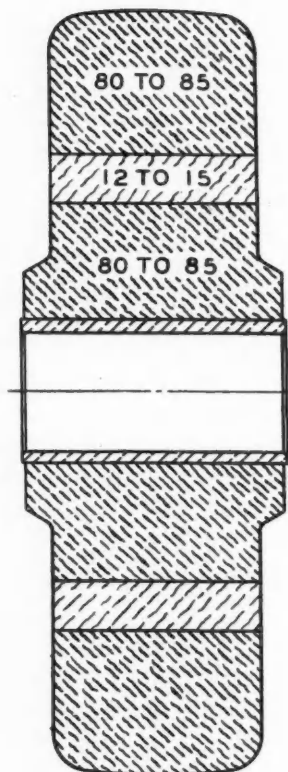


Fig. 4—Section of cushion wheel. The numbers indicate the durometer hardness readings of the softer and harder rubber sections

condenser at the rate of approximately 7000 cu. ft. per min.

Considerable experimenting was required in the development of this fan,

for the reason that railway cars must operate in both directions, and the fan, therefore, sometimes heads into the wind while at other times it trails the unit. A pressure-type fan had to be developed for installation on high-speed trains, for it was found that at speeds of 100 m.p.h. and over the wind pressure is too great for the conventional three-blade propeller-type fan.

The engine is equipped with a high-tension magneto, oil filter, 32-volt, solenoid-operated starter, and a V-belt drive with automatic tightener.

A number of unique features are embodied in the design of the unit. Referring to the sectional view, it will be seen that the compressor-drive pulley is full-floating and that a flexible-disc drive is used for the compressor, which eliminates crankshaft deflections due to belt tension. In this connection it may be pointed out that there is need for a good mechanical seal between the compressor crankcase and the atmosphere, to prevent escape of refrigerant. The seal consists of a bronze member floating in a duprene rubber ring operating against a revolving hardened steel member on the crankshaft, and it is obvious that any perceptible shaft deflections would destroy the effectiveness of the seal. Owing to the extreme precautions taken against such deflections, there is rarely any trouble from leakage of refrigerant gas at this point.

The speed modulator is an important feature of the ice engine. It is actuated by pressure variations in the crankcase of the compressor and con-

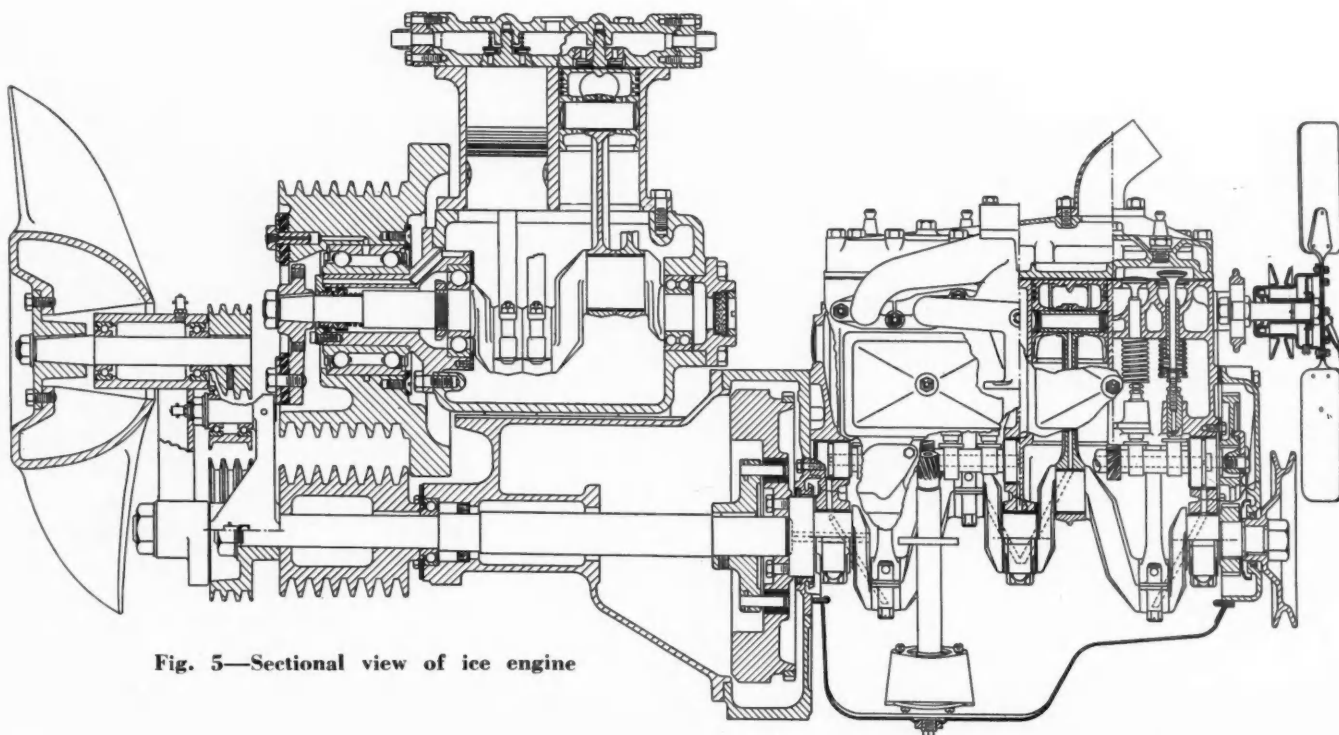


Fig. 5—Sectional view of ice engine

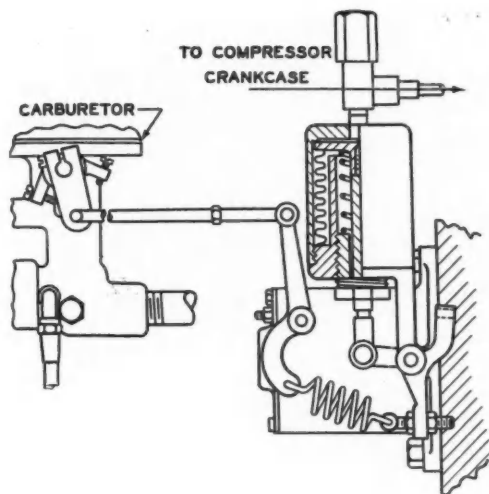


Fig. 6—Modulated engine speed control

trols the built-in governor within the engine speed range. With this device, when the cooling demand is reduced, the engine speed is reduced, instead of the engine being stopped and restarted later. This results in a constant low temperature on a portion of the evaporator coil, which provides continuous dehumidification, a feature that is said to be exclusive to this system.

The slide switch provides automatic control and acts as a guard against overloading. It is operated by the pressure in the intake manifold, the piston moving up and down in accordance with this pressure. In the illustration, it is in the starting position, the contacts are closed, and the starter is engaged. As soon as the engine comes up to its governed speed, the lower pressure or vacuum will move the piston downward, breaking the starter contacts, and at the same time closing the solenoid by-pass valve on the compressor.

When the piston reaches its extreme downward position, contacts are made which control the solenoid refrigerant valve adjacent to the evaporator in the car, and refrigerant liquid is then permitted to pass through the evaporator. Should the pressure in the system exceed the maximum permissible operating pressure of 250 lb. per sq. in., the added engine load will cause the manifold vacuum to be reduced, and the piston to move upward. This breaks the circuit controlling the solenoid in

the evaporator, thus reducing the load on the engine.

Waukesha units are furnished to the railways in three different combinations, depending on the type of service. Combination 1 consists of the ice engine and fuel supply and provides for air-cooled condensers only. Most of these installations are operating in territory north of Chicago.

Combination 2 is used more extensively than any other, and consists of the ice engine, fuel supply, plus an evaporative sub-cooler which is a self-contained unit equipped with a fin-type cooling coil, circulating water pump, sprays, and a 40-gal. water supply. Refrigerant travels from the ice engine to the evaporative sub-cooler, and then to the evaporator. The purpose of the sub-cooler is to provide maximum capacities and lower refrigerant pressures under abnormal conditions, such as when operating across the desert where temperatures may run as high as 132 deg. Fahr.

Combination 3 consists of an ice engine, fuel supply, and an evaporative condenser which is equipped with a fin-tube-type cooling coil, circulating water pump, sprays, and a 175-gal. water supply. In this combination, the ice engine is not equipped with air condensers and fan, and water is required at all times for operation. It is designed for use in tropical and sub-tropical territory.

In addition to the above systems designed for use on propane, Waukesha Motor Co. has also developed a system to be operated on natural gas.

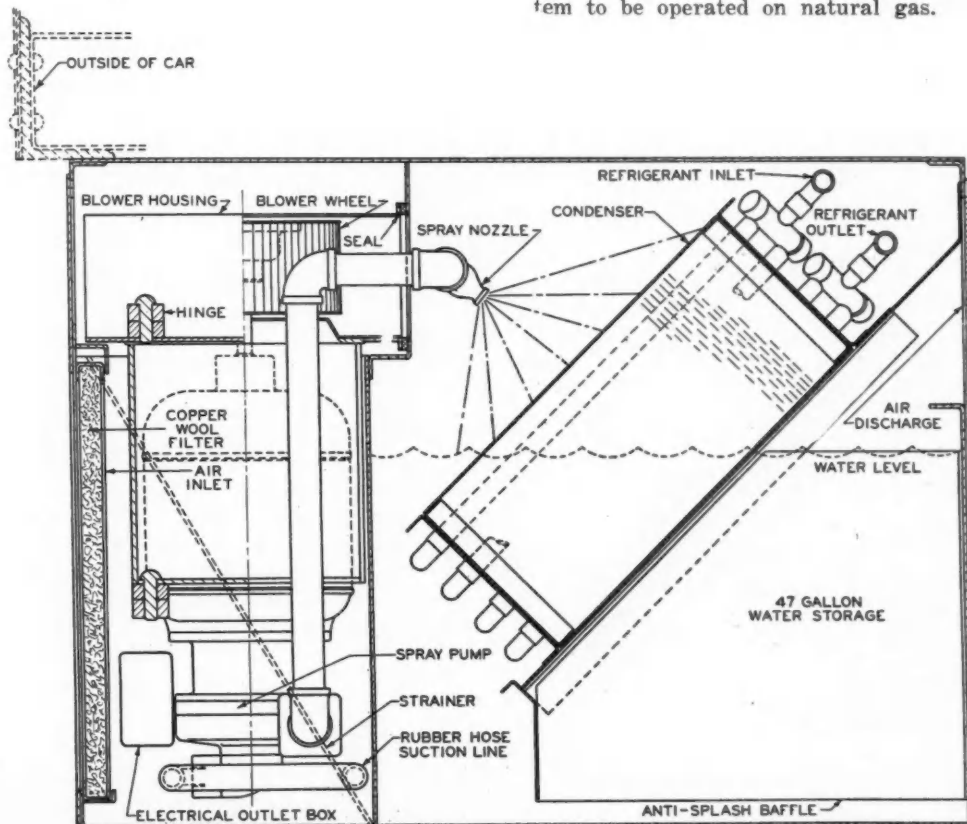


Fig. 7—Cross section of evaporative sub-cooler



## TOOLS OF TOMORROW

(Continued from page 771)

worm is finished, thus permitting removal and insertion of the work.

The depth feed cam is made so that the majority of the stock is removed with a fairly coarse feed, then the feed is reduced for the remainder of depth of cut, and finally the cutter is allowed to dwell for several revolutions without any down feed, to produce a smooth finish on the work.

### Scroll Chucks

... Scherr alters design and sizes of Taylor self-centering unit.

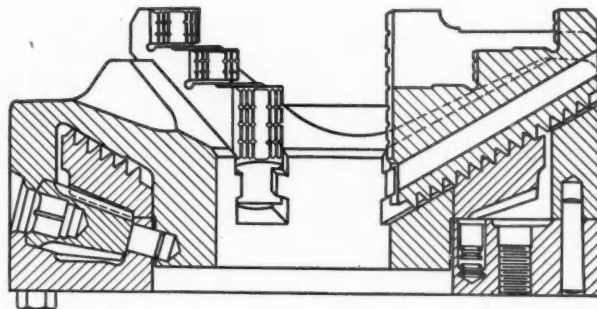
Although the principle on which the Taylor self-centering scroll chuck is constructed has been generally known for some time, George Scherr Co., New York, reports that the design and size have recently been altered to make the unit adaptable to modern manufacturing methods, especially for use with high-speed machine tools.

The gripping power of this chuck is said to be at least twice that of the ordinary scroll chuck, an important feature in applications where tungsten carbide cutting tools are used.

A high tensile cast iron is used for the body of the chuck, the front face of which is in the form of a hollow cone. The jaws slide in ways cut into this face. In all sizes above 8½ in. the central portion of the body passes through the back of the chuck. Internal working parts are retained in position by this back which contains a recess for locating the adapter.

The spiral is made of steel hardened and ground true. It has teeth in the back and is revolved by means of any one of three pinions. The front face in the form of a hollow cone has cut upon it a spiral V thread which engages with the teeth cut in the back of the jaws, thus advancing or with-

Cross-section view of new Taylor self-centering scroll chuck built by Scherr.



drawing the jaws simultaneously and gripping the work true without setting. Jaws are supported immediately behind and at right angles to the line of pressure caused through gripping the work.

Jaws are made of special steel and hardened all over. After hardening they are ground true on the parts which slide in the chuck body, and also in position, on the parts which grip the work. Two types of jaws are usually supplied with the chuck, one for general lathe work and another for holding bars, etc.

The bevel pinions for revolving the spiral are of chrome nickel steel. They are electrically heat treated and ground and tested before assembling.

A cross-section view of the chuck is reproduced herewith.

depth, then the depth feed is disengaged and the traverse feed engaged to traverse the rack table in the opposite direction.

### Modern Gears Require Modern Methods

(Continued from page 776)

is easy to understand when we recall that the only perfectly fitted flat surfaces are those found on optical flats or Jo-blocks. Another advantage is that the involute spline lends itself readily to accurate and even precise measurement, whereas the spur splines were never measured accurately, except for

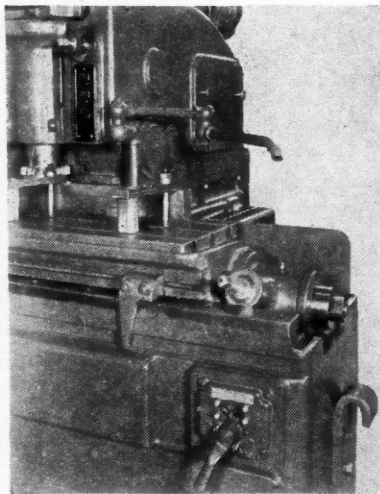
### Rack Shapers

... Fellows machines for cutting spur and helical tooth racks.

Two new rack shapers arranged for cutting spur and helical tooth racks have been brought out by the Fellows Gear Shaper Co., Springfield, Vt. The machines are identical except for the length of rack that can be cut; model 3-48 will cut rack lengths up to 48 in., and 3 in. face width, while model 3-60 will cut rack lengths up to 60 in.

The base is of heavy box section, and carries a table mounted on ways and actuated by a lead screw and change gears. The bed is mounted on a similar box section base, located at right angles to the base carrying the table. Position of the bed, when the cutter is in action on the work, is controlled by a feed cam which, in conjunction with change gears, controls the depth of cut and the depth feed per stroke of the cutter. The saddle carrying the cutter-spindle is of the "relieving" type, and is mounted on substantial trunions supported in the bed and actuated by a positive and smooth-operating relieving mechanism.

The machine can be used to finish a rack in either one or two cuts by the setting of selector switches, and operates automatically for the second cut without any attention on the part of the operator. That is, at the completion of the roughing cut, the cutter is automatically fed in to finishing



Close-up view of Fellows rack shaper for cutting spur and helical tooth racks.

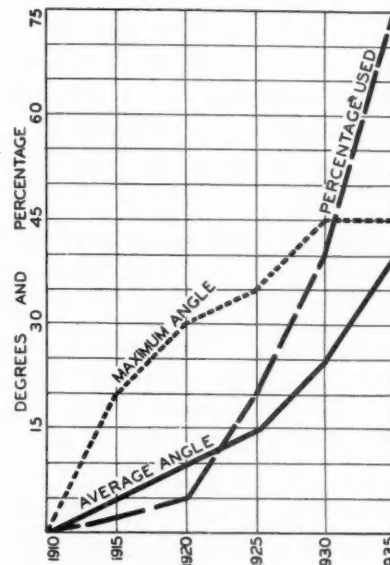
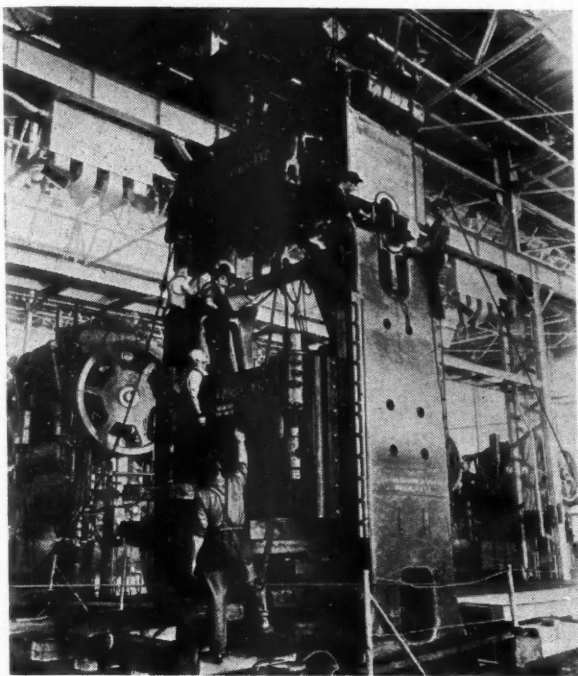


Fig. 9—Helical gearing in passenger cars for the years 1910 to 1935 inclusive.

width, and usually without regard to variation in thickness.

Finally, the involute spline can be corrected by salvage lapping for variations due to fire distortion. At least 80 per cent of the new shafts used in current car production feature the involute spline, and where the lapped spline is combined with a hole rebroached after heat treat in the gear bore, it is possible to effect an excellent fit with respect to accurate indexing and limits of clearance or back-lash.



The above press is a recent DeSoto acquisition, a mammoth double-crank toggle. It weighs 400,000 pounds and will exert a million pounds of pressure on the plunger. It's the biggest press yet installed at DeSoto for sheet metal pressing or stamping. In the above picture, workmen are shown lowering the massive crown into place.

## Production Lines

### Flying Mike

Continuous steel mill practice which has incorporated the use of the flying shears now marks the advent of the "flying mike." Behind this news is the dramatic story of how the familiar "Electrolimit Gage" has been harnessed to the rolling mills so as to aid in the production of deep drawing stock within very fine tolerances on thickness. One application on a 42-in. 5-stand tandem tin mill maintains sheet thickness within plus or minus two ten-thousandths (0.0002) in. As we see it, P & W now provides gaging for the entire motor car from the machine shop right into the body and sheet metal.

### Safety

Air-conditioning as a boon to worker comfort and health was discussed by A. G. Hillen, Carrier Corp. engineer. Where excessive heat is generated in industrial operations, suitable air-conditioning systems have reduced the number of prostrations, benefited the health of workers, and increased production. In addition, such installations are a great aid in safety work in the removal of dusts and small particles of metal or irritant chemicals.

### Fifteen Degrees

Washington news dispatch has it that the city of Cincinnati has enacted an ordinance limiting to 15 deg. the differential in the temperature of any air-conditioned building with respect to outside temperature. This has been endorsed by authorities in the air-conditioning field, according to the report, as "correcting the erroneous operation of air-conditioning installations." This may have a bearing, to some extent at least, on the practice in air-conditioning of motor vehicles.

### Coloring Copper

A new method of coloring the surfaces of copper or copper alloys, re-

cently reported in a foreign technical journal, utilizes water solutions of potassium permanganate, potassium chlorate, and potassium hydroxide as the coloring agents.

The finished color of the surface is controlled by varying the proportions of the solutions used and the time and temperature conditions. The temperatures used in treating the metals vary from 150 deg. to 197 deg. Fahr., and the time of treatment ranges from 5 to 60 minutes. The coloring obtained can be varied from straw-yellow through golden-yellow, dark red, red-brown, and dark brown to deep black.

### Cutting Oils

*Research Illustrated*, a Houghton publication, reports the first fruit of a scientific investigation of cutting oils in which all the variables entering into the problem of cutting metals were carefully controlled and studied. Despite the volume of literature on cutting fluids, the testing procedure still is largely a matter of cut-and-try and factory men may well profit by the results of these carefully conducted tests. Call on us for copies of the preliminary report which is to be followed later by complete details of procedures and results.

### World's Biggest

The copper refining capacity of the United States is more than half of the total capacity of the world, according to the Yearbook of the American Bureau of Metal Statistics. At the end of 1936 capacities in short tons based on both electrolytic and furnace methods were as follows:

United States .....	1,642,000
Canada .....	195,000
South America .....	368,000
Europe .....	629,000
Asia .....	108,000
Africa .....	97,000
Australia .....	45,000

Total .....3,084,000

### Without Stint

It is a noteworthy fact that one motor car builder whose name must remain anonymous, at least so far as we are concerned, made it possible for a fairly large proportion of his workers to remain employed during the model changeover period. Many of these people were occupied with "made" work of such nature as to make it plain to us that this manufacturer was doing his bit to fill the pay envelope. If this isn't true social consciousness, we'd like to know what it is.—J. G.

## Evolution of Cadillac Sixteen Engine

(Continued from page 783)

is the way each of the centrifugal pumps forces water directly rearwardly into the water distributing tube. A series of involute scoops cast in that portion of the cylinder block forming the rear face of the pump housing, collect water from the outside of the pump volute and force it axially toward the rear apparently violating all principles of centrifugal pump de-

sign. Research, however, has developed scoops which are entirely effective, the pump efficiency being higher than is usual with centrifugal pumps of conventional design.

### Accessory Drive

The two water pumps, the fan and the generator are driven by one pair of dual belts arranged as illustrated on

page 783. An unusual feature is the common drive for fan and generator. The same dual belts drive both the generator and the fan, yet, to achieve quietness the fan is rotated at a somewhat lower speed than the engine crankshaft, while a high charging rate at low car speed is assured by driving the generator at 1.95 times engine speed. This is accomplished by a step-up friction drive for the generator. On page 783 is shown a section through the drive mechanism. The fan is driven directly by the dual belts which also drive a shaft supported by a double row ball bearing and to which is secured a drum containing a rubber driving ring against which is pressed the generator driving wheel. The mechanism is supported in such a manner that independent adjustment may be made of either the belt tension or the frictional contact between the generator driving wheel and the internal rubber ring.

### Realization of Aims

Upon the completion of any project, it is always interesting to compare the final product with the original aims. The objectives of the sixteen-cylinder engine development are listed at the beginning of this article. They are repeated below with comparative figures for the old and new engines which indicate the achievement of the desired goal.

(1) *Power.* 185 horsepower at 3600 R.P.M. or almost precisely the same as that of the former sixteen.

(2) *Compactness.* The table below lists overall dimensions exclusive of accessories.

	Former 12	Former 16	New 16
Length, inches ..	43	51½	45½
Height, inches ..	30	30	18
Width, inches ...	19	19	23½

The volume of rectangular boxes just large enough to enclose the three engines would be as follows:

	Former 12	Former 16	New 16
Volume, cu. ft..	14.2	17.1	11.1

Related to piston displacement, the new engine has 39 cubic inches displacement per cubic foot of space it requires while both the former twelve and sixteen had only 26 cubic inches displacement per cubic foot.

	Former 12	Former 16	New 16
(3) Light Weight Engine weight including clutch and control and all accessories, lbs. ....	1165	1300	1050

	Former 12	Former 16	New 16
(4) Simplicity Total number of parts .....	2810	3273	1627



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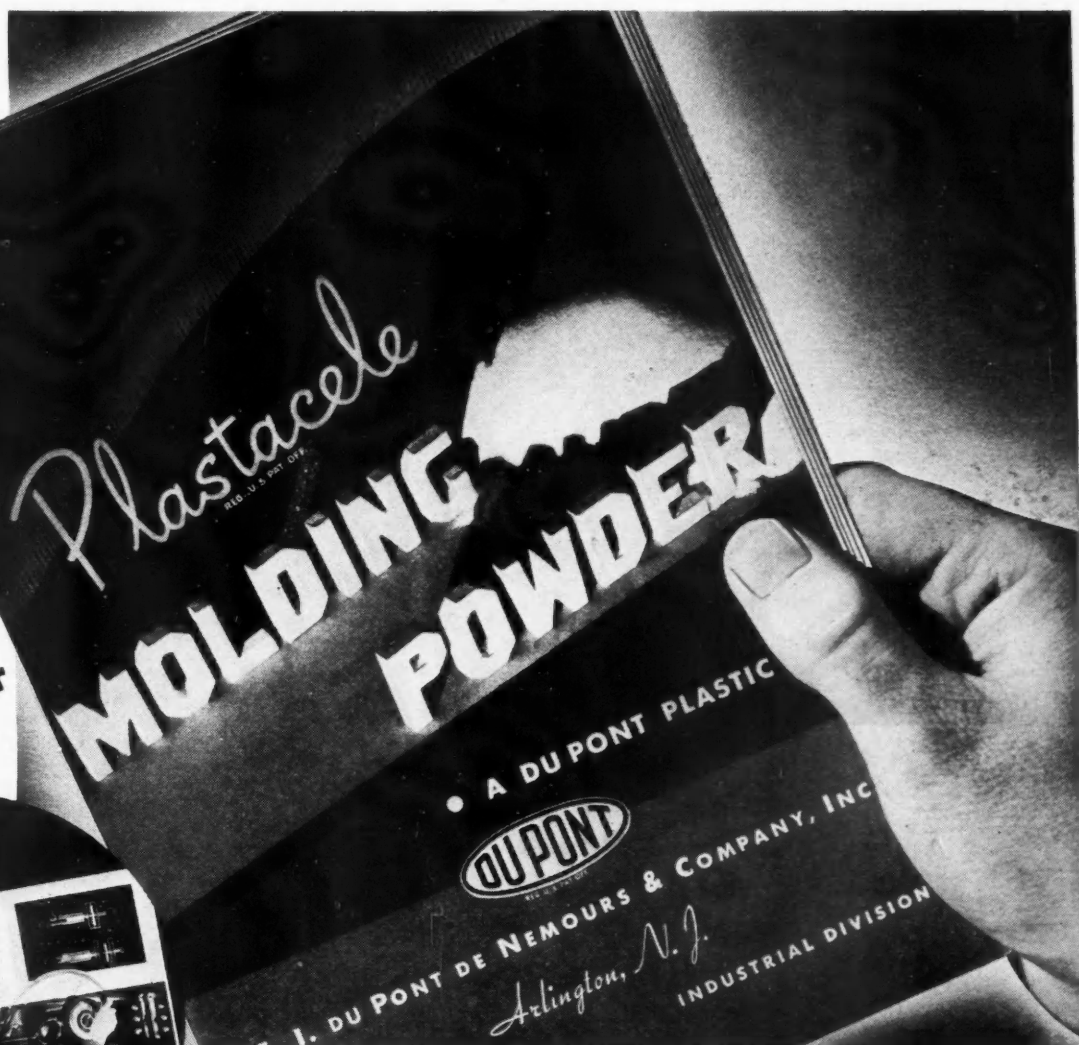
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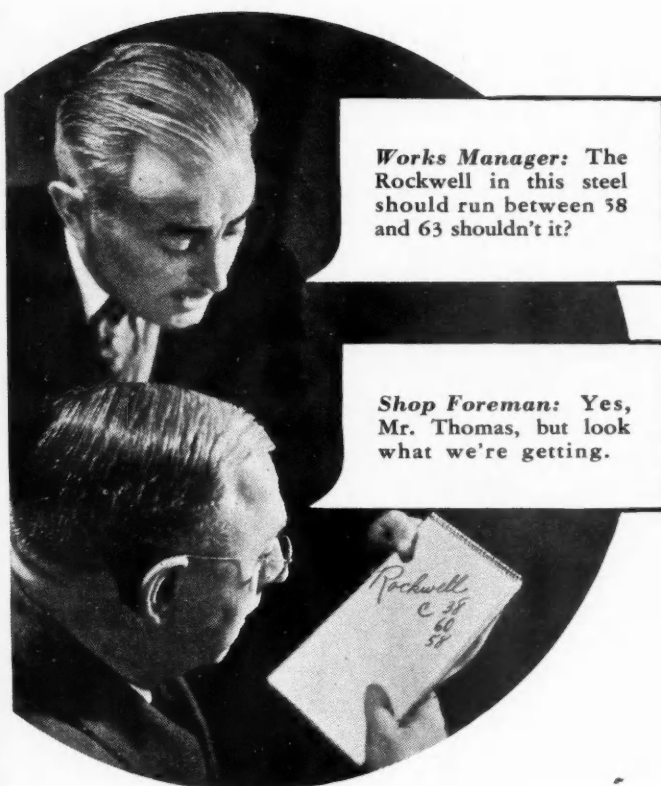
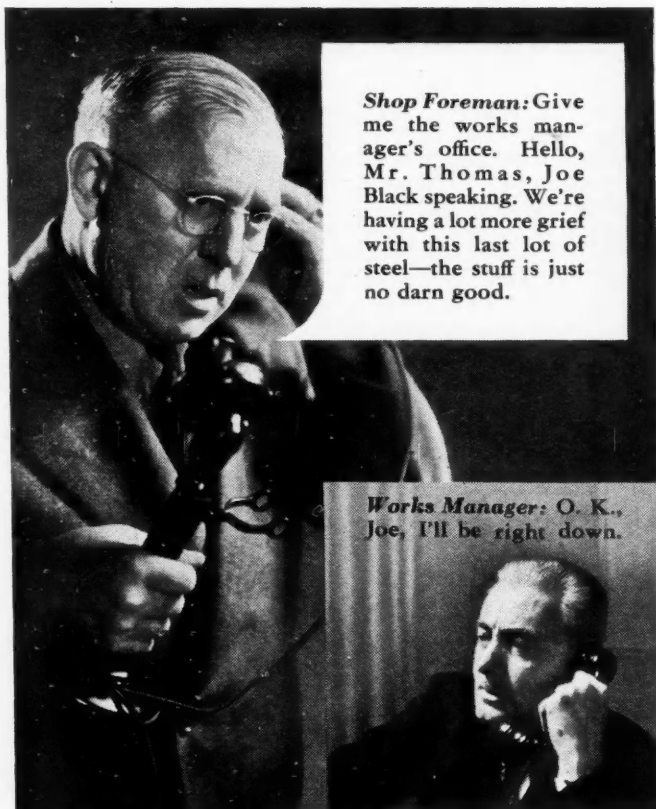
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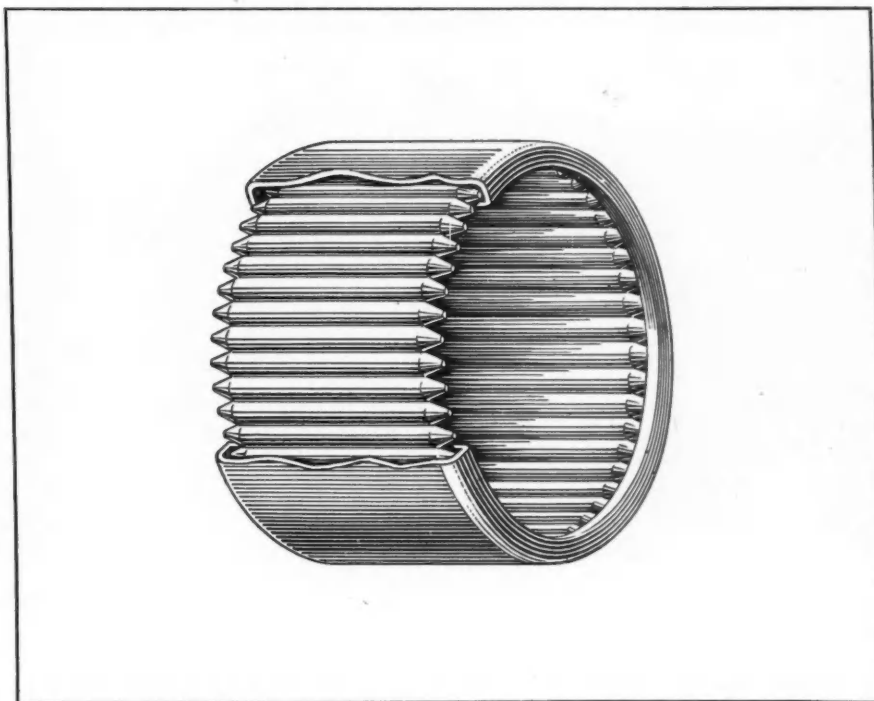
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